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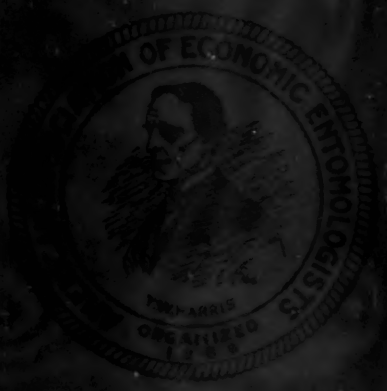

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SOIL INSECTICIDE INVESTIGATIONS AT THE JAPANESE BEETLE LABORATORY DURING 1923

By B. R. LEACH, W. E. FLEMING and J. P. JOHNSON[1]

ABSTRACT

The experimental work thruout the year with *Popillia japonica* has been carried on with the object of evolving methods of chemically treating the soil about the roots of such plants as conifers, boxwoods, azaleas, rhododendrons, hydrangeas, ferns, blueberries and perennials for the control of the soil stages of the Japanese beetle. Emulsions of carbon disulfide and wormseed oil have proved satisfactory in these connections and are now in use by the local nursery and greenhouse concerns.

The Japanese beetle is now gradually spreading over an area in New Jersey and Pennsylvania within which is centered a large proportion of the nation's nursery interests. Since the insect inhabits the soil throughout the greater part of its life and is found about the roots of plants almost anywhere within this area, a quarantine has been established prohibiting the shipment of soil, or plants with soil about their roots to points outside unless freed of possible infestation. Under these circumstances the experimental work during the past four years has been carried on along fundamental lines with the object of devising various methods of soil treatments which would cover the treatment of different types of nursery stock grown within the area. In addition to the above problems, an important side line has been the study of controlling the larvae in specialized areas of turf, such as lawns and golf greens.

During these four years the writers have tested practically every chemical which offered possible merit as a soil-insecticide. Included in this broad survey of the chemical field is a two-year study of organic compounds made for the specific purpose of finding new soil insecticides. The work, which will be published in the near future, indicates that no

[1]Contribution from the Japanese Beetle Laboratory, Bureau of Entomology U. S. D. A. in cooperation with the Departments of Agriculture of the States of New Jersey and Pennsylvania.

compound is equal to carbon bisulphide as a general soil insecticide for the control of the egg, larva, and pupa. Considering its toxicity to the insect, it has the least deleterious action upon plants of any compound known when properly handled. Under the circumstances and in view of the lack of other chemicals of all-around value, the work has unavoidably centered upon a fundamental study of this compound and its effect upon the insect, the soil, and the plant.

One of the first problems arising in connection with the Japanese beetle project consisted in devising a method of freeing the soil (destined for greenhouse potting purposes) of any stage of this insect. A complete report[2] of this work has been published, embracing a study of the fumigation of soil with carbon bisulphide in a closed container. The results indicate that the treatment of loose soil in a tight container by the interspersion of definite injections of liquid carbon bisulphide is a cheap and efficient method for this purpose when used at the rate of 13 fluid ounces per cubic yard of soil. It was found that the diffusion of the carbon bisulphide vapors throughout the soil varied directly with the depth from the surface of the soil and inversely with the lateral distance from the point of injection. The soil type when the soil was thrown loosely into the fumigating chamber was not a limiting factor. Soil moisture became a limiting factor when it approached the saturation point; the soil temperature impaired the efficiency of the method when it fell below 50° F. When used at the above rate, the treatment did not affect the subsequent growth of herbaceous plants. The method is now in general use by the nurseries within the infested area. In the same way as above a study was made of the fumigation of plants, with balls of earth about their roots, in closed containers. No difficulty was encountered in killing any insects present (aside from those in puddled soils) but the aerial portions of the plants did not survive the treatment.

When carbon bisulphide was injected into the soil of potted plants or about the crown of plants growing in the nursery row in concentration heavy enough to secure 100 per cent control, the plants were injured with the one outstanding exception of Japanese azalea.

In view of the above results the writers began a series of fundamental experiments involving the use of carbon bisulphide with water as a carrying agent. It was found that 100 per cent control could be secured in practice but the mixture of carbon bisulphide and water was uncertain, due to the dependence of the concentration on the temperature of the

[2]Fleming, W. E. Fumigation of potting soil with carbon bisulfide for the control of the Japanese beetle. *In* N. J. Agr. Exp. Sta. Bul. 380.

water and the degree of agitation while preparing the solution. In view of this incompatability the writers carried on an extensive study of the emulsification of carbon bisulphide in order that the dosage might be controlled. The work involved the testing of the hydrophile colloids as emulsifying agents. It was found, in common with other investigators on this subject, that soap was by far the best emulsifying agent—especially the rosin-fishoil soaps. In the absence of standard brand soaps a stable emulsion can be made by the use of sodium or potassium oleate, or some other higher fatty acid.

With carbon bisulphide, emulsified by these methods and capable of being measured accurately and dispersed in water, the compound was tested upon various types of plants which were quarantined or in danger of being quarantined. The work, in addition to the study of the factors influencing the larval kill in the soil, included the experimental treatment of French hydrangeas, Japanese azaleas, rhododendrons, blue berries, ferns and other plants. It was found that plants in general would withstand a dose of the emulsified compound greater than that required to control the insects present. In the case of French hydrangeas a concentration of 0.5, 0.625 cc. of emulsified carbon bisulphide per liter of water controlled the insect in the soil when a volume of solution equal to one-half the volume of the treated soil was applied. The plants were growing in a sandy soil low in organic content and were treated by placing galvanized iron collars in the soil, applying the required amount of solution and allowing it to drain into the soil. At the end of 48 hours, the plants were dug, potted in wooden tubs and placed in the greenhouse. The tops of the plants remained normal while the feeding rootlets were sheared off by the action of the chemical. Within two weeks the plants had replaced these feeding rootlets and resumed a normal growth. In other words the plants experienced a temporary check in growth due to the action of the compound on the roots but rapidly recovered and resumed growth with a varying degree of stimulation.

In the case of Japanese azalea, rhododendron, blue berry, fern and other ericaceous plants which prefer an acid soil containing an abundance of peat, it was found that the amount of emulsified carbon bisulphide necessary to secure complete insect mortality depended upon the amount of organic matter present and that in every case the plant had greater resistance than the insect. Employing this method the writers have to date successfully treated 1,500 cibotium and aspidium ferns belonging to one of the local nurseries and valued at $10,000. Experimental data is now at hand to insure the successful treatment of azaleas, rhododendrons,

blue berries, hydrangeas, ferns and other similar potted plants during the next growing season. A detailed report of this phase of the work is now in preparation and will be submitted for publication in the near future.

The same general scheme has been followed experimentally in the treatment of evergreen nursery stock such as boxwood, pine, spruce, hemlock, arborvitae, retinispora, yew, etc. The work has been done under nursery conditions and the results indicate that the method will have considerable application in the treatment of this type of nursery stock as grown in the infested area. The aerial portion of the plant is uninjured and the feeding roots are rapidly replaced. Early and late fall treatments have been made and will be continued during the next spring and summer.

As indicated above, the methods evolved all necessitate the treatment of the plant by pouring the toxic liquid on the surface of the soil and allowing it to percolate thru the soil mass, the plants being either in pots or growing in the field. Considerable experimental work[3] has been done in respect to digging infested plants, wrapping them in burlap, and dipping them in the toxic solutions. The experimental results indicate that the soil absorption and possibly some other soil phenomena interfere with the action of the toxic material under these conditions. Considerable work is now being done along these lines.

While the experimental work to date involving the dipping of large balls of soil has been negative in character, it has been found that the dipping method has a considerable application in the treatment of matted and hollow rooted plants such as phlox, iris, and peony where only small amounts of soil are present. In this connection the carbon bisulphide emulsion dip has been applied to the treatment of peonies and American wormseed oil emulsion dip to the treatment of Japanese iris, phlox, hemerocalis, sedum, etc. During the past two years, the writers have treated 75,000 plants of this nature grown by two local nurseries and valued at $25,000. In view of the fact that large acreages of these types of plants are grown in this immediate vicinity, it is very probable that this method will have a large application. The results of this phase of the experimental work have been submitted to the Department for publication.

Aside from these phases of the work involving the treatment of nursery stock, the problem has arisen of controlling the larva in lawns and golf courses where it is frequently present in such large numbers

[3]Leach, B. R. and Thompson, J. W. Soil treatment to control the Japanese beetle larvae about the roots of coniferous plants. *In* Soil Sci. 12, 43-59.

that the turf is severely injured and often killed outright. Experimental work along these lines has been conducted during the past three years and the results have been published from time to time.[4] During August and September of this year, the writers treated the 27 greens of two local golf courses which were heavily infested and severely damaged by this insect. A complete report of this phase of the work has been published in the October 1923 number of the Bulletin of the Green Section of the United States Golf Association.[5] The results indicate that from the standpoint of cost and efficiency, the method will have a considerable application in the treatment of such valuable areas of turf as lawns and golf greens.

In connection with growing potted plants, it is often desirable to have small areas of soil such as cold frames, etc. free of larval infestation in order that these potted plants may be plunged therein. Experimental work conducted during the past three years indicate that soil treated with acid arsenate of lead at the rate of 1,500 pounds to the acre, the material being thoroughly worked into the soil to a depth of 4 inches, will kill the larva present within a period of two weeks, depending upon the soil temperature. The method is now in use within the infested area. Experimental results indicate that the majority of plants are very sensitive to arsenic but of the hundred odd varieties of plants tested in this connection there are several outstanding examples of plants which will grow in soil treated at the above dosage of lead arsenate equally as well as in the untreated soils. The method has however a limited application in this respect and for this reason the writers have been carrying on experiments during the past two years with the object of coating the individual particles of the lead arsenate with some material which will preserve the lead against soil action and thereby protect the toxic properties until it is taken into the stomach of the larva. This work is now being continued along these lines with several definite leads in sight.

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[4]Leach, B. R. The Japanese beetle in relation to golf courses. 1921. *In* Bul. Green Sect. U. S. Golf Assoc. 1, no. 10, 210–211.

Leach, B. R., and Thomson, J. W. 1923. A control for the Japanese beetle larvae (Popillia japonica Newm.) in golf courses. *In* Jour. Ec. Ent. 16, 312–314.

Leach, B. R., and Thomson, J. W. A control for the Japanese beetle larvae (Popillia japonica Newm.) in golf greens. *In* Bul. Green Sect. U. S. Golf Assoc. 3, no. 6, 173–174.

[5]Leach, B. R., and Johnson, J. P. 1923. The Japanese beetle; its life-history and control in golf greens. *In* Bul. Green Sect. U. S. Golf Assoc. 3, no. 10, 262–268.

SELECTIVE PARASITISM BY *TIPHIA* SP.[1]

By H. A. JAYNES, *Assistant Entomologist*, and T. R. GARDNER, *Junior Entomologist, United States Department of Agriculture*

ABSTRACT

It has been observed during the past several years that the larvae of *Ochrosidia immaculata* became very numerous on a golf course in the vicinity of Moorestown, N. J. Within the past two years, the abundance of the larvae has been reduced approximately 95 per cent. by a native species of fossorial wasp belonging to the genus *Tiphia*. In the same manner the parasite increased in numbers and as the abundance of the host was reduced the numbers of the parasite decreased nearly 95 per cent. At the same time a related Scarabaeid, *Popillia japonica*, became very numerous in the same locality. Under conditions in the field only two *Popillia* larvae were found to be successfully parasitized by the native *Tiphias*. Experiments which were conducted indicated that the female *Tiphia* deposited her eggs, by preference, on the *Ochrosidia* rather than on *Popillia* larvae. The life histories of *Ochrosidia immaculata* and *Popillia japonica* are similar in this region, but the former larvae are larger than the latter, when both are full grown. Nevertheless during the latter part of August, when the *Tiphias* are present, many *Popillia* larvae have reached the third instar in their development; while many *Ochrosidia* larvae are in the second instar and are smaller than the *Popillia* larvae which have reached the third stage.

It is evident that, at present, this species of *Tiphia* is selective in its preference for its native host, but since it is possible for some individuals to develop successfully on the *Popillia* grubs, it is possible the *Tiphias* may develop a strain which will become parasitic on this introduced species.

For the past three seasons while studying native species of insects likely to become parasitic upon the larvae of *Popillia japonica*, several interesting points were observed relative to the parasitism of native Scarabaeid larvae. Most of our field observations were confined to an area of three or four square miles in the vicinity of Moorestown, N. J. During the summer of 1921, there was an infestation of *Ochrosidia* (*Cyclocephla*) *immaculata* on the Moorestown Golf Course. There were not enough larvae present to cause noticeable injury to the sod. The number of Japanese beetle larvae present was small since this territory had been infested for less than two years. Although search was made for native parasites, particularly species of *Tiphia*, none was found at this time.

ABUNDANCE OF TIPHIAS AT MOORESTOWN, N. J., IN 1922

In the summer of 1922, on the same course, it was noticed that areas of sod were loose and could be easily pulled up. Later in the season the grass died and turned brown. This condition of the sod was caused by

[1]Contribution from the Japanese Beetle Laboratory, Riverton, N. J.

the feeding of a large number of *Ochrosidia* larvae upon the grass roots. A few *Popillia* larvae were found at this time but not in sufficient numbers to cause damage to the sod. Thirty-eight female *Tiphia*[2] were collected in the vicinity of Moorestown at this time and placed in tins with *Popillia* larvae. The *Tiphia* laid 72 eggs, all of which they placed dorsally between the second and fourth segments. Several of these eggs hatched and the larvae partially developed; but with one exception never became sufficiently matured to spin perfect cocoons. One *Popillia* larva, upon which a *Tiphia* larva was feeding, was also found in the field. The parasite was situated between the second and third dorsal thoracic segments, and developed sufficiently to spin a perfect cocoon. This was the first case known of a Japanese beetle larva being parasitized in the field by a species of *Tiphia*.

In the fall of 1922, several diggings were made to ascertain the number of larvae present in the area where the injury to the sod has been observed and in adjacent areas. The area of each digging was usually one square yard made in representative portions of the field. It was found that there was an average of 151 *Ochrosidia* larvae, 8 *Popillia* larvae and 44 *Tiphia* cocoons to each square yard. Finding *Tiphia* cocoons at this time indicated that the adults were present in considerable numbers during the summer although none was collected in this particular locality except on wild carrot blossoms bordering the course.

Experiments and Observations in 1923

In the early spring of 1923, it was found that the number of *Popillia* larvae and *Tiphia* cocoons was about the same as in the fall although the *Ochrosidia* larvae were less numerous due to winter kill and disease, the highest mortality being found in the areas where the dead grass had been removed by rakings. At this time cocoons were found as numerous as 114 to each square yard, while there were only 56 *Ochrosidia* larvae in the same area. In another square yard, 27 cocoons and 211 *Ochrosidia* larvae were found. On further diggings over 3,000 cocoons were obtained at the Moorestown Golf Course in an area of 60 to 70 square yards. Finding such a large number of *Tiphia* cocoons is an unusual occurrence.

Experiments were conducted to further determine whether the *Tiphias* would parasitize and successfully develop on the larvae of *Popillia*. The usual method of rearing the parasite was to place a single

[2]Most of these are *T. punctata* as far as we know, but it is very probable that at least another species or two may be present.

fertilized female *Tiphia*, in a six ounce salve-tin partially filled with soil in which were placed three *Popillia* grubs. Daily examinations were made and those larvae on which eggs had been deposited were removed to individual tins and fresh grubs placed in the tin with the adult parasite. From a total of 363 female *Tiphias*, 250 of which were reared and 113 collected in the field, only 25 eggs were deposited on *Popillia* larvae. These were placed on the dorsal side usually between the third and fourth segments. From these only one developed sufficiently to start spinning a cocoon. It died, however, before the cocoon was completed. A large cage was built in which was placed about four inches of soil covered with sod and well stocked with third-instar *Popillia* larvae. Over 100 male and female *Tiphias* were placed in this cage. Several plants of *Cassia chamaecrista* L. were transplanted to the cage in order that the adult parasites might obtain their usual food from the extrafloral nectaries which occur on these plants. Later, upon examination, not a single parasitized larvae or cocoon was found, which indicates that this species of *Tiphia* does not readily attack or develop on *Popillia japonica*. Also it was observed in the experiments that when an adult female *Tiphia* was placed in a tin containing three or four *Popillia* and only one *Ochrosidia* larvae, the egg or eggs laid would invariably be placed on the *Ochrosidia* lavra. This year, however, another *Popillia* larva was found in the field bearing a *Tiphia* larva on its dorsal segments. This parasite developed and formed a cocoon.

The latter part of August, the male *Tiphias* were first found in small numbers. They later increased in abundance so that in making sweepings with the net, hundreds could be collected. No females were found until several days after the meals became numerous. They were then obtained in small numbers, later increasing, but never becoming as numerous as the males.

In the fall of 1923, several diggings were made and an average of only 11 *Ochrosidia* larvae to the square yard was found. In some plots none was present at all, while the most found in any single square yard was 25. This was a decided decrease in number as compared with last year. However, the number of *Popillia* larvae was decidedly increased to an average of 142 to each square yard, and in one plot, nearly 250 larvae were found. In regard to the *Tiphias*, cocoons were very scarce, averaging only 2 to each square yard.

Comparing the figures obtained from the diggings made in the autumn of 1922 and autumn of 1923, it was found that in the latter season, the number of *Ochrosidia* larvae was reduced 93 per cent, and the number of

Tiphia cocoons was likewise reduced 95 per cent; while the number of *Popillia* larvae was increased 94 per cent. It might at first be assumed that the *Ochrosidia* larvae were reduced entirely by parasitism. This of course was the largest factor causing the reduction; but disease and winter kill also helped in the decrease as was before mentioned.

Conclusions

It has been observed during the past several years that the larvae of *Ochrosidia immaculata* became very numerous on a golf course in the vicinity of Moorestown, N. J. Within the past two years, the abundance of the larvae has been reduced approximately 93 per cent by a native species of fossorial wasp belonging to the genus *Tiphia*. In the same manner the parasite increased in numbers and as the abundance of the host was reduced the numbers of the parasite decreased nearly 95 per cent. At the same time a related Scarabaeid, *Popillia japonica*, became very numerous in the same locality. Under conditions in the field only two *Popillia* larvae were found to be successfully parasitized by the native *Tiphias*. Experiments which were conducted indicated that the female *Tiphia* deposited her eggs, by preference, on the *Ochrosidia* rather than on *Popillia* larvae. The life histories of *Ochrosidia immaculata* and *Popillia japonica* are similar in this region, but the former larvae are larger than the latter, when both are full grown. Nevertheless during the latter part of August, when the *Tiphias* are present, many *Popillia* larvae have reached the third instar in their development; while many *Ochrosidia* larvae are in the second instar and are smaller than the Popillia larvae which have reached the third stage.

It is evident that, at present, this species of *Tiphia* is selective in its preference for its native host; but since it is possible for some individuals to develop successfully on the *Popillia* grubs, it is possible the *Tiphias* may develop a strain which will become parasitic on this introduced species.

NATURAL ENEMIES OF BEET LEAFHOPPER (*EUTETTIX TENELLA* BAKER)

By Henry H. P. Severin, Ph.D., *California Agricultural Experiment Station*

Abstract

Among the natural enemies of the beet leafhopper (*Eutettix tenella* Baker) are a large number of predaceous insects which prey upon the nymphs and adults. Seven species of egg parasites, two species of Pipunculus flies, a Dryinid and a hair-worm were bred by various entomologists in California. The percentage of parasitized

hoppers gradually increases during the summer months and reaches its height during August (35.1 per cent). The weak point in the parasitism of the leafhoppers occurs on the plains and foothills where 4.4 to 8.2 per cent were parasitized during the winter and 1 to 1.5 per cent during the spring.

I. Introduction

The importation of natural enemies to control introduced injurious insects in the United States and Insular possessions has been attempted with many pests. Although these imported parasites and predaceous insects assist in checking the multiplication and in certain years control the host, nevertheless, fluctuations in the abundance of the natural enemies and pest occur, so that parasitism can not be regarded as a dependable control year after year, except possibly in a few instances.

II. Sugar Cane Leafhopper Controlled by Natural Enemies

The best example generally known among sugar producers is the control of the cane leafhopper (*Perkinsiella saccharicida* Kirk.) by natural enemies in the Hawaiian Islands. After the accidental introduction of the sugar cane leafhopper, many natural enemies already present in Hawaii transferred their attacks to this pest, but it was not until after special importations of parasitic and predaceous insects that the hopper was brought under complete subjection. In the cane fields today, a large number of different enemies prey upon the nymphs and adults, such as spiders, earwigs, long-horned grasshoppers, preying Mantids, kissing-bugs, ladybird beetles, Pipunculus flies, Dryinids, predatory wasps and others. According to Muir (8), natural enemies control 90 per cent of the hoppers in the sugar cane fields.

Egg Parasites.—Among the imported natural enemies, egg parasites play an important role in the control of the cane leafhopper. It must not be assumed, however, that these egg parasites are the only factors in the control of the cane leafhopper. "When the hoppers increase to a serious extent through conditions unfavorable to the egg parasites, it is to the enemies of the nymphs and adults that we must look for a speedy reduction." Muir (8).

Local Outbreaks.—According to Muir (8), "every year there are a certain number of 'outbreaks' over limited areas. Most of these pass off without any appreciable damage to the cane, fully controlled by the parasites; a smaller number cause some damage before the parasites can control them, and a few do considerable damage."

III. Predaceous and Parasitic Enemies of Beet Leafhopper

According to Hartung (5) three predaceous bugs prey on the beet leafhopper in California: *Neides muticus* Say; *Zelus socius* Uhl.; and *Reduvicolus kalmii* Reut. Spiders were noticed by the writer feeding on the hoppers in the field. In the greenhouse control measures must be adopted against the Argentine ant (*Iridomyrmex humilis* Mayr.) which enter the cages, kill the nymphs and occasionally the adults, and carry them to their nests. In cages the green lacewing larva (*Chrysopa californica* Coq.) devours the leafhoppers. Specimens of *Geocoris pallens* Stal were frequently seen sucking out the juices of nymphs and adults. A reddish mite attached to the body of the beet leafhopper was sometimes observed.

Egg Parasites.—Hartung (5) bred three egg parasites from the egg of the beet leafhopper determined by A. A. Girault as follows: *Abella subflava* Girault; *Anaphes* sp. near *hercules;* and *Gonatocerus* sp. The last two egg parasites emerged from eggs of the beet leafhopper from Ravendale, Lassen County, California. Stahl (10) bred *Abella subflava* Girault at Riverside and calls attention to the fact that this was a primary egg parasite and not a hyper-parasite as Hartung (5) states. Stahl (10) reared two other egg parasites, *Polynema eutettixi* Girault and *Anagrus giraulti* Craw., at Spreckels and Riverside. The writer bred four egg parasites from the eggs of the beet leafhopper in the San Joaquin Valley as follows: *Polynema eutettixi* Girault; *Anagrus giraulti* Craw.; *Apelinoidea plutella* Girault; and *Anthemiella rex* Girault. These egg parasites were reared more abundantly from eggs deposited by the beet leafhopper in saltbushes (Atriplexes) than in sugar beets.

Parasites of Nymphs and Adults.—Two parasitic flies were bred from the beet leafhopper,—*Pipunculus vagabundus* Knab and *P. industrius* Knab. A wingless ant-like wasp (*Gonatopus contortulus* Patton) and the winged male were bred from the beet leafhopper. A parasitic hair-worm belonging to the Gordiaceae emerged and was also dissected on rare occasions from the beet leafhopper. A case of double parasitism by a hair-worm and a Pipunculus larva occurred in the abdomen of a single dark overwintering female collected on the foothills near King City in the Salinas Valley on November 28, 1918. The beet leafhopper was also parasitized by an occasional Stylops which was not bred.

The Pipunculus flies deposit an egg in the nymph or adult beet leafhopper. The egg hatches into a larva or maggot which feeds within the abdomen of the hopper. When the larva is full-grown it bores out

of the host, leaving a large exit hole usually at the junction of the metathorax and abdomen. The hopper is killed after the larva emerges. After escaping from its host, the larva buries itself beneath the soil and pupates. At Spreckels the flies issued after remaining in the pupal stage for a period of 22 days.

The female of *Gonatopus contortulus* is a wingless, ant-like parasite of the family Dryinidae. Mr. S. A. Rohwer determined "the two parasites bred from the beet leafhopper as *Gonatopus contortulus* Patton, and *Labeo* sp. n. He says that this male is no doubt that of the above female. There is much confusion about the males of Labeo, of which no female is known. Some male Labeo are males of females described in Gonatopus and Dryinus."

The ant-like female is a very active creature, capturing and partly devouring a large number of hoppers. A single parasite emerging in a cage will kill most of the leafhoppers, but it is only in an occasional leafhopper that an egg is deposited. The presence of the parasite in its later development can be determined by the external dark brown sac in the nymph or beneath one of the wings in the adult leafhopper. After the parasitic larva quits its host, it spins a white cocoon (length 3 mm. width 1.5 mm.) on the foliage of the saltbush or beet leaf. Forty days, after spinning its cocoon, the wingless parasite emerged on October 24, 1914 at Spreckels.

Percentage of Parasitism.—We (6) have published a paper on the natural enemies of the beet leafhopper and in 1913, about 3.2 per cent and in 1914, about 33.6 per cent of the leafhoppers collected in beet fields were found to be parasitized by *P. vagabundus*, *P. industrius* and *G. contortulus*.

During 1918–1920, a comparison was made of the percentage of parasitized beet leafhoppers collected on the plains and foothills with those captured in the cultivated areas of the San Joaquin Valley. Records obtained by dissecting the adults are more reliable than those secured by breeding the parasites, since a high mortality of the insects occurs in the breeding jars. The average percentage of parasitized adults of various broods by Pipunculus and Gonatopus is indicated in Table 1.

The weak point in the parasitism of the adults occurs on the plains and foothills. Dissections show that only those winter brood adults, which are parasitized by a tiny larva, fly to the foothills resulting in an extremely low percentage of parasitism of the spring brood. It is evident from Table 1, that the percentage of parasitism gradually

TABLE 1. PARASITISM OF BEET LEAFHOPPER ON PLAINS AND FOOTHILLS AND IN CULTIVATED AREAS OF SAN JOAQUIN VALLEY

Plains and foothills				Cultivated Areas			
Year	Months	Broods	Average percentage parasitism	Year	Months	Broods	Average percentage parasitism
1918–1919	Nov.–Mar.	winter	8.2	1918	Dec.	winter	28.0
1919	Apr.	spring	1.0	1919	Apr.–May	spring	3.5
				1919	June	summer	10.0
				1919	July	summer	22.3
				1919	Aug.	summer	35.1
				1919	Sept.	summer	32.0
					average	summer	25.5
1919–1920	Oct.–Feb.	winter	4.4				
1920	Apr.	spring	1.5				

increases during the summer months in the cultivated areas and reaches its height during August.

IV. IMPORTATION OF NATURAL ENEMIES

In 1917–'18 Vosler (12) attempted the importation of natural enemies from Australia to California to control the beet leafhopper. One female Dryinid was imported and oviposited in the beet leafhopper confined in cages but no parasites were bred. The parasitism of this Dryinid of a leafhopper (*Eragrostis villosa*) in New South Wales was approximately 7 per cent. Two introduced egg parasites found "*E. tenella* an unsuitable host." In Victoria 85 to 90 per cent of the eggs of a leafhopper deposited in a saltbush (*Atriplex muelleri*) were parasitized by the two egg parasites.

Sugar company officials have frequently asked the writer as to the possibility of controlling the beet leafhopper through the importation of natural enemies. According to Ball (1) "*E. tenella* is a native insect inhabiting southwestern United States and northern Mexico, with an extension of area in the Columbia River region." The writer has taken large numbers of this insect on the Australian Saltbush (*Atriplex semibaccata*) at Mexicala, Mexico. Mr. E. P. Van Duzee (11) captured many specimens of *E. tenella* on islands in the Gulf of California as follows: "Isla Raza, April 21, abundant on Atriplex; Isla Raza, May 4, on Salicornia; Santa Inez Island, May 13, on Atriplex and Chenopodium, growing together rankly in masses; Ceralbo Island, June 7, on Sesuvium. Here they were larger and mostly pink in color, greatly resembling,

although distinct from, *rubicundulus* Van Duzee from Jamaica." Ceralbo Island is situated near the southeastern end of Lower California. Boncquet (2) found the beet leafhopper and curly leaf beets in the Argentine Republic, South America. The specimens of *E. tenella* were determined by Mr. E. P. Van Duzee and are in the collections of the California Academy of Sciences.

If the distribution of the beet leafhopper from Washington and Idaho south into Mexico represents the native home of this insect, then the natural enemies are not efficient agents of control. It is not to be assumed that all native insects are controlled by their parasites.

Entomologists probably would immediately come to the conclusion that the beet leafhopper was accidentally introduced into the Argentine Republic, but a careful consideration as to the possibilities that such has occurred is met with difficulties. If eggs deposited in weeds, or nymphs or adults have been transported in hay or straw from a beet leafhopper territory to the Argentine Republic, none of the three could survive in the dried vegetation. The possibility of introducing this insect in connection with the sugar beet and stock beet does not seem plausible. The only possibility that the writer can think of is, that eggs deposited in the foliage of garden or red beets or swiss chard taken from the breeding grounds of the leafhopper and transported in cold storage on steamers to be used as a vegetable dish or greens for the crew or passengers, may have hatched if taken ashore in the Argentine Republic. It is questionable, however, whether the eggs would survive in cold storage during a long trip around Cape Horn, possibly before the Panama Canal was completed. If the pest was accidentally introduced, it could have established itself easily on plants of the family Chenopodiaceae, to which the sugar beet belongs.

The distribution of insects is often limited by the geographical range of the native food plants. In all probability, the native host plants on which the summer and overwintering broods develop are representatives of the Chenopodiaceae. Dr. H. M. Hall (4), who has recently published a monograph on the Atriplex and other genera, has prepared for the writer a brief statement concerning the geographical distribution of the species of Atriplex and Chenopodium as follows:

> Atriplex. There are numerous species throughout western North America as far south as tropical Mexico, the number of species as well as individuals diminishing towards the South. Too little is known of the botany of tropical America, but the genus is well represented in the West Indies, and occurs in Honduras and Venezuela. There are 2 or 3 species in Peru and Bolivia, more in Chile, and several in Argentine.
>
> Chenopodium. *C. murale*, an introduced European weed, has been abundant

for a long time on the American continents. It is reported as almost continuous in its distribution, but it cannot now be verified for the tropics. *C. ambrosioides* is a native in warm temperate and tropical America and is now common from eastern Canada and California to Brazil and Argentine. It occurs only as an introduced species in the northern part of its range and perhaps in the extreme south in South America.

The present known distribution of the beet leafhopper corresponds with the geographical range of Red Stem Filaree (*Erodium cicutarium*), the most important winter host plant in which the dark overwintering adults deposit their eggs and on which the spring brood develops in California. According to Thornber (9) Red Stem Filaree now covers parts in Washington, Idaho, and Texas and the whole of Oregon, California, Nevada, Arizona, New Mexico and Utah. Hemsley (6) records Red Stem Filaree from "North Mexico, Monterey (Eaton and Edwards); South Mexico, Tacubaya (Bourgeau, 30), at the foot of the mountains of Orizaba (Schiede and Deppe), without localities (Hahn, Bates. etc.) Hb. Kew." Specimens of *E. cicutarium* are in the herbarium of the botanical department at the University of California collected by Dr. Nicolas Illin labeled as follows: "Flora Argentina, Terriorio del Chubut, 1903, No. 24."

Red Stem Filaree is supposed to have been originally introduced into America from the Mediterranean basin by the Spaniards although there is some difference of opinion among botanists. According to Brewer and Watson (3) *E. cicutarium* is "very common throughout the State, extending to British Columbia, New Mexico, and Mexico; also widely distributed in South America and the Eastern Continent. It has been generally considered an introduced species, but it is more decidedly and widely at home throughout the interior than any other introduced plant, and according to much testimony it was as common throughout California early in the present century as now." The possibility that the beet leafhopper was accidentally introduced in Red Stem Filaree from Europe is entirely out of consideration for if this plant was introduced into America from the Mediterranean basin it was through the seed carried in the wool of sheep.

A study should be undertaken as to the geographical distribution of the beet leafhopper for it does not seem possible that the range of this insect occurs from Washington and Idaho, south through the tropics into Argentine, South America. Dr. E. C. Van Dyke, an authority on the distribution of the Coleoptera, informed the writer that species of beetles are widely separated in the north and south temperate regions and that

there are but few native species of the United States which extend through the tropics into the south temperate zone.

If it is demonstrated that the leafhopper through migratory flights, has established itself in localities outside the range of its efficient parasites, then every effort should be made to introduce parasites into such natural breeding areas. Before any attempt is made to introduce natural enemies, a careful study should be undertaken of the habits of the parasites in their natural environment. If imported natural enemies were liberated on the plains and foothills of a natural breeding ground in California, and a spring dispersal of the parasites did not occur, they certainly would not survive after the pasture vegetation becomes dry. The habits of the parasites would require careful study in their native habitat to determine whether they would winter over in the cultivated regions or whether autumn dispersal and hibernation occur on the plains and foothills. Parasites should not be introduced into the migratory breeding districts of the leafhopper for it is a well known fact that when insects migrate from their natural breeding areas, they fail to establish themselves in their new environment unless they meet conditions identical with their original habitat. Preliminary experiments should be conducted with the egg parasites already attacking the eggs of the beet leafhopper in California to determine the proper methods of breeding them. There are many other factors to be taken into consideration in the importation of natural enemies, such as the question of general or specific primary parasites, secondary parasites, and environmental factors, which need no further discussion.

V. Acknowledgments

I am deeply indebted to Mr. A. H. Gahan, Bureau of Entomology, Washington, D. C., for the determination of the egg parasites bred in the San Joaquin Valley. Credit is due to Mr. W. J. Hartung for the determination of the percentage of parasitism of the spring and summer brood adults of 1919.

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TEMPERATURE AS A LIMITING FACTOR IN THE LIFE OF SUBCORTICAL INSECTS

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ABSTRACT

The distribution of insect species within a log depends to a very large degree upon the temperature in different parts of the log. The most heat resistant groups, of which the genus Chrysobothris is representative, are found only in the warmer parts, whereas those species less resistant to heat are found only where extremely high temperatures do not occur. On the basis of temperature it is possible to divide the insect inhabitants of a log into several ecological groups.

The importance of temperature as a limiting factor in the life and distribution of insects in general has long been recognized by biologists. In most of our discussions of the effect of temperature upon the distribution of terrestrial organisms we have thought most frequently in terms of large areas, but now we are beginning to realize the importance of this factor in limited environments. We now know that steep temperature gradients occur in very short periods of time or within very short distances. This explains many of the puzzling instances of periodicity and peculiarities of local distribution among certain insects.

The effect of temperature upon the distribution of insects in a small

environment is well illustrated by the insect life in logs, particularly by those insects that live just beneath the bark. The present paper is based upon a series of experiments carried on in Itasca Park, Minnesota, at the University of Minnesota Forestry School and Experiment Station. These experiments have extended over a period of four years, during which time considerable data concerning the effect of physical factors of the environment upon insects attacking logs have been accumulated.

For the purpose of this article it seems desirable, for the sake of simplicity, to select for discussion only a few insects, representing several ecological groups. The insects included in the experiments just mentioned that seem to best satisfy our requirements are as follows:

1. *Ips pini* Say
2. *Monochamus scutellatus* Say
3. *Chrysobothris dentipes* Germar

These species are very abundant and reacted very definitely to temperature conditions.

The Effect of High Temperatures

Before we can interpret field observations correctly we must usually have as a basis laboratory experiments. This study of temperature effects is no exception, and a knowledge of temperatures fatal to those insects that we are considering is essential. As all of the observations upon which this paper is based were made during the summer season, the effect of extremely low temperatures is not considered.

Table I illustrates the effect of high temperatures upon the adults and larvae of these three species.

Table 1. Fatal High Temperatures in °C

Species	Stage	Minimum death temperature	Average death temperature	Maximum death temperature
Monochamus scutellatus	Adult	43	47	50
	Larvae	45	48	50
Ips pini	Adult	44	48	50
	Larvae	44	46	49
Chrysobothris dentipes	Adult	45	50	52
	Larvae	—	—	

These figures show a considerable individual variation in death temperature in both the adult and larval stages. Cases must frequently occur in nature where an entire brood would be destroyed if it were not for some of those exceptional individuals that fall without the

average. It would appear that if it were not for these erratic individuals, adaptation of a species to new or changed environmental conditions would be difficult if not impossible.

Subcortical Temperature Conditions

Most of us think of bark as an excellent insulating material, and from this idea the assumption arises that a log may be regarded as a buffer medium and that the forms of life beneath the bark are protected to a large degree from sudden temperature changes and from extremes of temperature. The insulating power of bark is not so great as we usually suppose. The work of Craighead (1920) calls the attention of entomologists to the high temperatures that occur under the bark of logs lying in the sun. He points out that solar radiation may raise the subcortical temperature above a point fatal to the insect inhabitants of the logs. The author (1920) has shown that the chief factors influencing subcortical temperatures may be summarized as follows:

1. Solar radiation
    a. Light intensity
    b. Solar altitude
    c. Angle of incidence
2. Character of bark
    a. Color
    b. Surface
    c. Structure
    d. Thickness
3. Air temperature
4. Air movement
5. Evaporation from bark surface
6. Proximity to other radiating or absorbing surfaces

The highest temperatures recorded in these experiments were observed beneath the dark colored bark of white pine. Color of the bark determines to a very considerable degree the amount of solar heat absorbed by the bark surface. Thus, other things being equal, the darker the bark the higher the subcortical temperature. Frequently the noon temperature exceeded a point fatal to most insects and several times exceeded 60° C. Table II, shows the subcortical temperatures that were observed at noon under various shade conditions. The influence of character and thickness of the bark is illustrated in Table III.

TABLE II. NOONDAY SUMMER SUBCORTICAL TEMPERATURES IN WHITE PINE LOGS IN °C[1]

Degrees of shade	Maximum	Minimum	Average
0	65.0	17.5	45.6
1/3	54.0	15.5	36.5
1/2	48.0	14.0	34.4
3/4	39.0	14.0	27.7
Complete	28.0	11.0	18.4

TABLE III. INFLUENCE OF BARK CHARACTER UPON SUBCORTICAL NOONDAY TEMPERATURE IN °C

Species	Bark Character	Bark Thickness	Maximum	Minimum	Average
White pine	Rough	13 mm	47.0	18.0	35.1
White pine	Rough	12 mm	48.0	17.0	36.4
White pine	Smooth	5 mm	53.0	17.0	40.6
Norway pine	Scaly	13 mm	45.0	18.0	32.7
Norway pine	Scaly	5 mm	45.0	17.0	32.8
Norway pine	Scaly	1.5 mm	46.0	17.0	33.8

This table shows that in white pine the thickness of the bark is an important factor determining the subcortical temperature, whereas in Norway pine the scaly character of the bark appears to be the more important. From this it naturally follows that there would be differences in subcortical temperature between different species. The next table illustrates this point more fully.

TABLE IV. VARIATIONS IN NOONDAY SUBCORTICAL TEMPERATURES BETWEEN LOGS OF DIFFERENT SPECIES IN °C[1]

Species	Bark Character	Bark Thickness	Maximum	Minimum	Average
White pine	Smooth	5 mm	55.0	17.0	40.0
Jack pine	Scaly	4 mm	51.0	17.0	38.0
Spruce	Scaly	2 mm	49.0	17.0	36.0
Norway pine	Scaly	5 mm	45.0	17.0	32.0

From these data it is obvious that a wide range of temperature may occur between logs of different species, between logs of the same species differing in color, character, thickness of the bark, and between similar logs under different conditions of shade. These facts, combined with our knowledge of the temperatures fatal to insects makes it possible to prophesy with a reasonable degree of accuracy where the insects under consideration in this paper would be found in nature. We should not expect to find *Monochamus scutellatus* living and developing on the

[1]Logs lying in a north and south direction, with north end slightly elevated. These figures are based upon data collected over four seasons.

upper side of white pine logs exposed to full sunlight except in the case of a few very thick barked logs. On the other hand, *Chrysobothris dentipes* with its much higher fatal temperature would find conditions satisfactory for its development on the upper side of many logs lying in the sun. We might also expect to find that the cooling effect of dense shade, although it might not be in itself fatal, would so reduce the rate of development of the insect inhabitants of logs placed in such situations that higher mortality than normal of the insects within the logs would result. That these theoretical deductions are in general correct is shown in Table V. In this table the actual distribution of these three species is illustrated.

TABLE V. DISTRIBUTION OF SUBCORTICAL INSECTS UNDER DIFFERENT CONDITIONS[1]

	Ips pini Say									
	Top side					West side				
	Degree of shade					Degree of shade				
Species	0	1/3	1/2	3/4	Full	0	1/3	1/2	3/4	Full
White pine....	1.1	40.2	77.1	131.4	42.1	67.4	56.1	98.8	91.8	50.0
Jack pine.....	0.4	9.2	33.5	64.4	21.6	21.7	36.1	43.7	33.6	23.5
Norway pine..	73.4	69.4	164.2	125.9	41.5	86.5	60.0	99.0	84.4	37.5
	Monochamus scutellatus									
White pine....	0.5	2.0	5.2	2.2		6.7	7.0	10.5	6.0	
Jack pine.....	1.6	0	1.3	0.6		2.6	4.3	1.3	2.0	
Norway pine..	1.0	1.0	0.6	1.0		4.0	2.0	3.0	3.0	
	Chrysobothris dentipes									
White pine....	19.7	17.2	2.5	0	0	2.7	0.2	0	0	0
Jack pine.....	17.0	5.0	0.6	0	0	0	0	0	0	0
Norway pine..	12.0	1.0	0.3	0	0	0	0	0	0	0

	Ips pini Say									
	East side					Bottom side				
	Degree of shade					Degree of shade				
	0	1/3	1/2	3/4	Full	0	1/3	1/2	3/4	Full
White pine....	69.9	74.9	90.5	64.0	39.3	23.3	21.2	23.1	23.2	38.5
Jack pine.....	39.7	48.0	63.1	33.9	27.0	17.4	19.3	12.5	14.7	19.6
Norway pine..	80.6	59.3	95.1	81.5	42.1	40.0	16.5	31.4	35.8	44.1
	Monochamus scutellatus									
White pine....	5.2	4.5	11.2	4.5		5.5	4.2	11.6	2.2	
Jack pine.....	1.3	4.0	1.3	0.3		3.0	2.3	2.3	1.0	
Norway pine..	1.3	1.6	4.3	1.3		4.6	3.3	1.3	2.0	
	Chrysobothris dentipes									
White pine....	4.0	2.5	0	0	0	0	0	0	0	0
Jack pine.....	3.0	0.6	0	0	0	0	0	0	0	0
Norway pine..	0.3	0	0	0	0	0	0	0	0	0

[1]Data presented in this table represents the number of insects present per unit area of one square foot.

The actual distribution of these three species as illustrated in this table is approximately what would be theoretically expected. On the upper side of jack pine and white pine, where very high temperatures occur, *Ips pini* and Monochamus are almost never found, whereas the sun loving species, *Chrysobothris dentipes* with its comparatively high fatal temperature finds such a location to its liking. In the Norway pine where lower temperatures maintain, we find an increased number of *Ips pini* and a decreased number of *Chrysobothris dentipes* in the warmest locations. On the lower side and under heavy shade there is a decided falling off in the abundance of all three species.

Conclusions

The three species considered in this paper show very definite temperature reactions and temperature doubtless plays an important role in the life of all of them. Temperature determines their rate of development, their distribution, and in many cases the per cent of their mortality. These experiments have shown such a variation in abundance of the same insect under different environmental conditions that the prospect of checking the development of insects in logs by controlling storage conditions is encouraging.

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A METHOD FOR THE EXTERMINATION OF THE ROUND-HEADED APPLE-TREE BORER

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ABSTRACT

As a substitute for the "digging-out" process, fumigation with carbon disulphid proved very successful. Against the tree, with the open side over the borer holes, a cell with open top, resembling a large mud wasp's nest, is built of plastic clay or mud. A teaspoonful of carbon disulphid is poured in and the cell closed with a plug of clay. The surface of the cell is then wetted and smoothed down, and carefully sealed to the tree and the earth. This method gives 100% control when properly done, requires less time than the "digging-out" process, and neither mutilates nor injures the tree.

In my little orchard, the past year, nearly all of the apple trees, about 40 in number, were badly infested with the round-headed borer. After some desultory work, attempting to dig out the larvae with a knife, I began the use of carbon disulphid. The results were so satisfactory that I will describe the procedure in some detail.

Slingerland and Crosby (Manual of Fruit Insects, page 192) say "Other kinds of borers in shade or park trees have been successfully treated by injecting a little carbon disulphid into the small hole from which the sawdust-like excrement is being pushed out, and the hole quickly plugged with putty or grafting wax. The deadly fumes of this very volatile liquid penetrate the burrow and finally kill the borers. Orchardists should give this sensible method a thorough trial. A similar treatment has been successfully used by some fruit-growers."

This method, while advantageous where the hole of the burrow is clear-cut, cannot well be applied in cases where there are a number of holes leading into communicating burrows, or where the holes are in part below the sod. Treatment by the method to be described was begun late in July, and continued, as more infested trees were discovered, until into September.

The following recommendations, if carefully observed, will completely control this apple-tree pest.

1. Clear away water sprouts, grass, and sod from around the base of the tree for a distance of 6 inches. This is good orchard practice in any case. Rough bark and borer-frass should also be brushed away. As the holes in some cases are found below the surface it is well to scratch the soil away from the base of the tree to the depth of about an inch.

2. After one or more days, the trees should be examined for indications of renewed activity of the borers to be sure that time is not wasted on a tree from which the borers have already departed. In some cases, especially late in the season, some weeks may elapse before more frass is thrown out after the tree has been cleared at the base.

3. Mix some fine, homogeneous clay with a little water, until it is perfectly smooth and has the consistency of putty or plasticine. Probably any fine soil will answer provided it is free from stones and sticks, and not crumbly. If the clay is from the surface and very dry it will facilitate matters to let it stand for several hours with a little water poured over it. A pail full of this plastic material is enough for five to ten trees. With increased experience a smaller amount of clay may be used per tree than at first.

4. Wet the soil at the base of the tree. If the soil is porous, work a

little clay into it. Against the tree, with the open side over the borer holes, build a clay cell with open top, resembling a large mud-wasp's nest. Have ready a flat piece of clay for a lid. The size of the cell is dependent upon the number of holes it has to cover.

5. Put a small, loose wad of paper in the cavity of the clay cell, pour over it a teaspoonful of carbon disulphid, and clap on the lid.

6. Quickly and firmly seal on the lid, wetting the surface of the whole cell, rubbing smooth with the hand, and sealing tightly to the ground and to the tree. If the clay or muck is of the right sort, an air tight cell is thus formed which communicates only with the burrows of the borers. If the clay cell is well constructed, the odor of the carbon disulphid is still apparent upon opening the cell 24 hours later. Upon investigation the insect will be found dead in its burrow. In my experiments I did not fail to kill the boreres *in situ* in a single instance.

A few cautions should be observed. Use fine clay or loam such as will work up well into a putty-like mass and is not crumbly. Seal the cell carefully to the tree and to the ground, smoothing the surface with the hand which has been dipped in water. If the ground is porous, floor the cell with clay also. Follow up your work after several weeks. Some of the borers may not have been active when going over the orchard the first time and thus have been overlooked. Mark the side of the tree which has been treated so that later on you may know how effective your work has been.

This method kills borers in the root-base as well as those in the trunk. A man working alone should be able to treat 50 trees a day effectively, which is more than can be done by the digging-out process, as figures, which have been kept by the Department of Pomology of Cornell University, show. The method is applicable to trees of any size and for borers of any age. It may be used at any time between May and October. It has the advantage over "digging out" in that it requires less time, neither mutilates nor injures the tree, and when properly done is 100% efficient.

Instead of clay, plasticine may be used. It is easy to apply, takes less time, is much less messy, and may be used several times over. The only objection to it is the expense. Whether the slight amount of oil in its composition has any injurious effect upon the tree remains to be seen. Dry, finely pulverized clay mixed with about one-fifth its bulk of vaseline makes a fair substitute for plasticine.

In a few cases where the borer holes were up some distance from the base, tar paper was used for the body of the cell and sealed to the tree

with clay. No time was saved however by the use of the paper. A pound of carbon disulphid at a cost, say of 40 cents, is sufficient for treating 75 to 100 trees. It is needless to add that the liquid is volatile, explosive in the presence of a flame, and poisonous, so care should be taken in handling it.

LUBRICATING-OIL EMULSION AS A CONTROL FOR *CHRYSOMPHALUS AONIDUM* IN GREENHOUSES

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ABSTRACT

The need for a more efficient contact insecticide for hardy ornamentals in greenhouses suggested the desirability of testing lubricating oil emulsion which had proved so effective for white flies in Florida, and recently against San Jose scale. In 1922 young Kentia palms, heavily infested with the Florida red scale, *Chrysomphalus aonidum* L., were sprayed one, two, and three times in succession with 1:50 (or 1-1/3%) "Boiled," and "Cold-stirred" emulsions. Formulas for each are given and appeared equally effective. In 1923 a miscellaneous group of infested plants, including Kentia, Phoenix, Aspidistra, Ficus, Laurus nobilis, Aucuba Japonica, and citrus sp. were sprayed with "Boiled" emulsion. The 1:32 and 1:25 dilutions left the foliage greasy and yellowed the palm fronds. Spraying once with the 1-1/3 % emulsion if thoroughly done gave a satisfactory control without injury to the plants. Results of experiments are presented in the table.

During the past ten years lubricating-oil emulsion has been used extensively in Florida for the control of white flies and scale insects in citrus orchards. More recently it has proved very satisfactory as a dormant spray for the control of San Jose scale in apple orchards in the Ozark region of Arkansas and Missouri.

The remarkable insecticidal efficiency obtained from a 2% emulsion, and the fact that it contained very little oil suggested the possibility of using this material on ornamental greenhouse plants infested with scale insects, because the margin of safety in the use of insecticides under glass is narrower than out of doors. The development of a contact insecticide having such qualities would meet a constant demand on the part of greenhouse men for a remedy which would be more effective against scale insects than nicotine soap solutions or other contact sprays and would be suitable for treating palms, Ficus and other hardy plants. Moreover, it could be used where circumstances would not permit fumigation with hydrocyanic-acid gas.

During the summer of 1922 a number of young Kentia palms heavily infested with the Florida red scale, *Chrysomphalus aonidum* Linn., were available for such a test. Preliminary experiments were undertaken to

determine whether this insecticide could be used safely at a strength which would kill the insects. Both the "boiled" and "cold-stirred" emulsions were prepared according to the following formulae[1] using Junior Red Engine Oil and potash fish-oil soap as ingredients.

Boiled Emulsion Formula		Cold-stirred Emulsion Formula	
Paraffin oil	gallons 2.	Paraffin oil	gallons 2.
Water	gallons 1.	Water	gallons 1.
Fish-oil soap	pounds 2.	Fish-oil soap	pounds 8.

In each case these stock emulsions were then diluted 1:50 (or 1–⅓ per cent), and applied to the infested plants by means of a one-gallon compressed-air sprayer. Some of these plants were sprayed two or three times in succession at short intervals in order to determine the relative efficiency of such treatment.

The results of the 1922 experiments, 1 to 10 inclusive which are presented in Table I indicate that the "boiled" and "cold-stirred" emulsions were about equally effective in controlling this scale insect. Moreover, differences in time intervals between successive applications produced no outstanding variation in control. The equated percentages of control are not included because the per cent normally dead in the composite check for the same period, viz, 5.9 per cent as shown in Experiment 11, was too low to reduce the control results materially. Experiments 1 and 6 represent the probable degree of control resulting from one application of the emulsion. The lower per cent of control obtained from similar treatments in Experiments 2 and 7 is explained by the fact that some of the observations were made before sufficient time had elapsed to allow all scales affected by the treatment to succumb. Two treatments at intervals of 11 and 26 days respectively as shown in experiments 3 and 8, and 4 and 9, gave very good control. Three treatments with intervals of 11 and 15 days between successive applications gave 100% control in Experiments in 5 and 10.

These preliminary tests gave such convincing evidence of the insecticidal action of the emulsions that it was deemed desirable to establish the usefulness of the "boiled" emulsion by further experiments under normal growing conditions. Such tests would not only furnish additional proof of its insecticidal efficiency but also throw more light on its effect on the plants.

Fortunately in 1923 a rather heavy infestation of Florida red scale, which was discovered in a house of palms at the Botanic Gardens, was

[1]Yothers, W. W. "Spraying for the control of insects and mites attacking citrus trees in Florida." U. S. Dept. Agr. Farmers' Bul. 933.

TABLE 1.—EFFECTIVENESS OF SUCCESSIVE SPRAYING WITH LUBRICATING-OIL EMULSIONS (1:50) FOR CONTROL OF CHRYSOMPHALUS AONIDUM LINN.

Number of experiment	Type of emulsion	Number of applications	Date of applications	Total period of observation	Condition after spraying		Percent control	Host	Remarks
			1922	Days	dead	alive			
1	Boiled	1	July 12	43	915	65	93.3	Kentia sp.	
2	do	1	Aug. 3	25	429	254	62.8	do	Some examined August 10
3	do	2	Aug. 3, 14	25	178	0	100.	do	
4	do	2	Aug. 3, 29	50	564	10	98.2	do	
5	do	3	Aug. 3, 14, 29	50	521	0	100.	do	
6	Cold-stirred	1	July 12	43	448	36	92.5	do	
7	do	1	Aug. 3	25	391	175	69.0	do	Some examined August 10
8	do	2	Aug. 3, 14	25	196	13	93.7	do	
9	do	2	Aug. 3, 29	50	323	3	99.0	do	
10	do	3	Aug. 3, 14, 29	50	780	0	100.	do	
11	Check	0	July 24 to Sept. 12	50	273	4357	5.9	do	Normally dead
			1923						
12	Boiled	1	June 14	27	151	0	100.	Kentia sp.	
13	do	1	June 14	19	325	5	98.4	Aspidistra lurida	
14	do	1	June 14	19	205	0	100.	Laurus nobilis	
15	do	1	June 14	19	335	3	99.1	Phoenix rupicola	
16	do	2	Aug. 3, 29	64	125	6	95.4	Kentia sp.	
17	do	2	Aug. 3, 29	52	1800	148	92.5	Aspidistra lurida	Live scales in folded leaf
18	do	2	Aug. 3, 29	63	375	19	94.9	Citrus sp.	Live scales on smooth upper surface of leaf
19	do	2	Aug. 3, 29	64	190	0	100.	Ficus elastica	

placed at our disposal to conduct these investigations. In addition to Kentia palms this house also contained such ornamental plants as *Phoenix rupicola*, *Aspidistra lurida*, *Ficus elastica*, *Laurus nobilis*, *Aucuba Japonica*, and *Citrus* sp., all of which were infested.

For the purpose of determining the possibility of increased control and the probable limits of plant tolerance, several plants were sprayed with a more concentrated emulsion. A single treatment with either a 1:32 or a 1:25 "boiled" emulsion killed 100% of the scale insects, but unfortunately it also impaired the ornamental value of the foliage by leaving it greasy, and, in the case of palms, causing the fronds to turn yellow.

To verify previous work with the 1:50 "boiled" emulsion, a miscellaneous group of plants growing in the palm house under normal greenhouse conditions was sprayed once, on June 14, using a 24-gallon Deming Sprayer equipped with a disk nozzle. From the results of experiments 12 to 15 inclusive, it is quite evident that very satisfactory control can be obtained from *one* application of this insecticide. In view of the fact that no injury had developed on these plants within seven weeks after treatment, the remainder of the plants was then sprayed twice in succession, viz, August 3 and 29 with a 1:50 boiled emulsion.

Final observations on the effects of two applications of the "boiled" emulsion are given in the table under experiments 16 to 19. In this connection it should be noted that scales found alive had apparently escaped contact with the insecticide even after two treatments. For example, most of the living scales listed in experiment 17 occurred in a group within a folded section of Aspidistra leaf. Also in experiment 18 live scales were found only on the smooth upper surface of a citrus leaf to which the emulsion had apparently failed to adhere. The plants have shown no evidence of injury from these treatments.

Assuming that two or three treatments at close intervals would insure complete control, it is doubtful whether the difference in effectiveness would be sufficient to justify the additional expense of application and the greater risk of injury. The results of these investigations demonstrate that spraying *once* with a 1:50 "boiled" lubricating-oil emulsion, provided it is thoroughly done, will give a very satisfactory control of the Florida red scale, *Chrysomphalus aonidum* Linn. without injury to hardy ornamental greenhouse plants.

A STILT-BUG, *JALYSUS SPINOSUS* SAY, DESTRUCTIVE TO THE TOMATO

By C. R. PHIPPS, *Mountain Grove, Mo.*

ABSTRACT

A stilt-bug, *Jalysus spinosus* Say is recorded as a serious pest of the tomato in Missouri. It is distributed from Maine to the Rocky Mountains and commonly occurs on the undergrowth of oak woods. It causes the blossoms to wither up and drop off, preventing the plants from setting fruit. The life-cycle, appearance, nature of injury, and control measures are briefly discussed.

This insect was first recorded as an enemy of the tomato in Missouri, several years ago. Its depredations have apparently not been as severe or its work may have been attributed to other agencies during the past few seasons, for no further record of its injury appears. During the past summer, however, the writer's attention was directed to it again, by an apparent blighting of the tomato blossoms in and around Mountain Grove and in other parts of the state. There was a consequent failure in the set of fruit and upon examination, early in July, it was found that there were many stilt-bugs present and that these insects were responsible for the damage done.

DESCRIPTION

Jalysus spinosus (Say) belongs to the family Neididae, order Heteroptera. The adult is a brown stilt-bug whose body, legs and antennae are very long and slender. The antennae are as long as the body, four-jointed, distinctly elbowed, have the tip of the first joint enlarged, and are clubbed at the ends. The beak is four-jointed with normal basal segment; head with a transverse incision before the ocelli. This species may be distinguished from others in the genus by the absence of spines on the vertex, and by the presence of an inclined rather than a decurved scutellar spine. The males are shorter and more slender than the females and average about 7 mm. in length. The latter average from 8 to 9 mm. in length.

The eggs are pale yellow or nearly white in color when first deposited and are about 1 mm. in length. They are cylindrical in shape and have convex, rounded ends as shown in Pl. 4, Fig. 2. They soon become much darker, varying from deep yellow to nearly brown just before hatching.

The newly hatched nymphs are about 1 mm. in length and are yellowish brown in color. The legs, antennae, and beak are darker, however. The body color becomes light green in the second instar, but the legs, antennae and beak undergo no change. There is no marked color change during the three remaining instars.

1.—Injury to blossom cluster.
2.—Eggs on tomato leaf (enlarged about 7 times).
3.—Nymphal stages and adult male and female.

Distribution and Food Plants

Jalysus spinosus Say formerly belonged to the Berytidae and has been referred to by Howard, Comstock and other writers in discussing that family. The insect has a wide distribution, having been recorded from New England to the Rocky Mountains. It is often found in the undergrowth of oak woods, according to Howard. This doubtless accounts for its abundance in the post oak sections of Missouri. It has been recorded as feeding on sumac, hazel, peach, corn, tomato, horse nettle, and several members of the Onagraceae or Evening Primrose family. The writer has noted it feeding on the eggplant as well as on corn and tomato in the garden, but has never been able to find eggs upon the former. During 1914 Somes recorded it from all parts of Missouri and as far north as Sioux City, Iowa.

Nature of Injury

The nymphs and adults of this species feed on the juices of the tomato and other plants. They injure the tomato by inserting their beaks in the stems, blossom buds, and fruit itself. (Pl. 4, Fig. 1) The principal injury results from the blossom and fruit stem punctures which cause the blossoms to wither up and drop off, or at any rate to fail to set fruit. Altho the insects are rather sluggish, the adults fly readily when disturbed and may be a factor in the spread of southern blight and other tomato diseases.

Life History

Since the insect failed to attract attention until about the middle of July, this season, the writer was unable to follow its entire life-cycle. The adults winter over under leaves and rubbish of various sorts, emerge in the spring and feed upon wild host plants until the more attractive truck crops are growing in the fields. The first generation of nymphs is probably passed on these wild hosts, the resulting adults migrating to the cultivated plants in June or early July. There are two complete broods and a partial third, on the tomato, according to our observations this season. Many nymphs of the third brood, on the tomato, failed to reach maturity owing to freezing weather early in November. Oviposition occurred abundantly on the tomato the latter part of July and again a little over a month later. The eggs are deposited, singly, on the upper and lower surfaces of the leaves, on the stems, and on the blossoms. Females in confinement averaged from 7 to 10 eggs each. These

eggs were laid over a period of from 1 to 4 days. Under field conditions the number of eggs per female would probably be greater. The majority of the eggs hatched in about three days. The average length of time from the egg to the adult stage was about 35 days. Table 1 shows the seasonal history of the insect. The writer began the study too late in the season to observe the early feeding on the wild plants and that part of the table is approximated.

TABLE 1. SEASONAL HISTORY OF *Jalysus spinosus* SAY AT MOUNTAIN GROVE, MO., 1923

Life Cycle	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.
Hibernating Adults	- - °	° ° °	° ° °	°				
First Generation		Nymphs	° ° Adults	° ° ° * *	* * *			
Second Generation				Nymphs	* * * Adults	* * * * * *	* * *	
Third Generation					Nymphs	* * Adults	* * * * * *	* * - -
Fourth (Partial)						Nymphs	* * Adults	* * - -

Table II gives the length of the various stages as observed during the past season.

TABLE II. LENGTH OF DEVELOPMENTAL STAGES AT MOUNTAIN GROVE, MO.

Stage	No. Days	Average No. Days
Egg	3–6	4.0
Ist Instar	3–10	6.5
2d "	3–11	5.0
3d "	2–10	5.6
4th "	4–8	6.0
5th "	6–10	7.2
	21–55	Averages 34.3

CONTROL MEASURES

Thoro applications of nicotine sulfate and Bordeaux mixture are effective in killing the nymphs and protecting the foliage from subsequent attack by adults. Two applications, the first as soon as migration to the tomato is noticed, and the second early in August when the majority of the first brood nymphs are present, should give effective control.

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CERTAIN WILD GRASSES IN RELATION TO INJURY TO CORN BY THE "BORER" (*DIATRAEA SACCHARALIS* FAB.) IN LOUISIANA

By THOS. H. JONES and W. G. BRADLEY, *Louisiana Agricultural Experiment Stations*

ABSTRACT

Corn grown in Louisiana is often severely injured by the "sugar-cane moth-borer," *Diatraea saccharalis* Fab. Ten stalks in a very heavily infested field gave an average of 46.2 larvae, pupae, and pupal cases to the stalk. Larvae have been found, especially during the fall and winter, in several wild grasses. Some of these grasses grow abundantly in areas where the borer causes so much damage to corn. It seems certain that severe injury to the corn is due to moths that fly to it upon issuing from these grasses in the spring.

During recent years there has been much complaint of injury to corn in Louisiana by the "sugar-cane moth-borer" (*Diatraea saccharalis* Fab.). Not having available any definite records concerning the amount of damage caused by the pest during the past it is not possible to say whether it is becoming more abundant, but in certain sections it would appear that injury to corn has been more noticeable of late. Judging by inquiries received at the Louisiana Experiment Stations this appears true, for instance, in the Parishes of East and West Feliciana and East Baton Rouge. The degree of damage to corn by the borer varies greatly. In some instances it is so serious that no crop of ear corn is made, but this is not usual. Commonly, however, many injured stalks break over; being so weakened that they are unable to stand even light winds. Injury to the shank, the cob, the kernels, and the shuck is also important, particularly since it often results in subsequent decay and offers opportunity for secondary injury by certain other insects.

As to how abundant the borer may become in corn the following figures are of interest. On September 5, 1923, ten stalks were cut at random from a small planting of late corn at Baton Rouge in which the silk on the majority of ears had turned brown. It was apparent, from a superficial examination, that the corn in this field was very heavily infested and later observation showed that, because of borer injury, no ears matured. Counts were made of the larvae, pupae, and pupal cases

found in the ten stalks. In all 254 larvae, 139 pupae, and 69 pupal cases were found; an average of 46.2 larvae, pupae, and pupal cases in each stalk.

In connection with *Diatraea saccharalis* we have recently spent some time in attempting to ascertain the importance of its wild food-plants in those sections where there has been so much complaint of injury to corn during the past few years. It was thought that the abundant growth of various grasses in these areas had some bearing on the abundance of the borer in corn. While the question of wild food-plants has been given some consideration by other investigators it was believed that it was well worth further study in these particular areas. Collections of larvae feeding in the stems of various grasses have been made and Dr. H. G. Dyar of the U. S. Bureau of Entomology has kindly identified the moths that have issued. Adults of *Diatraea saccharalis* have been reared from larvae taken from the stems of the following grasses:—*Panicum barbinode*, *Paspalum larrañagae*, *Panicum gymnocarpon*, *Panicum dichotomiflorum*, *Holcus halepensis*, and *Andropogon glomeratus*. The first two species were determined by Miss Agnes Chase of the U. S. Bureau of Plant Industry and the others by Dr. C. W. Edgerton of the Louisiana Experiment Stations. Some of these grasses do not appear to have been heretofore recorded as food-plants of *Diatraea saccharalis*.

Larvae were common in the stems of a small patch of Para grass, *Panicum barbinode*, at Baton Rouge on October 11, 1922; 25 being taken by one collector in 40 minutes. They were found in the stems of the same patch of grass when examinations were made on November 24, 1922, and on January 13 and March 24, 1923, but by the latter date had become scarce and only 2 larvae and 2 pupae were found in 40 minutes. Pupae were found on January 13 and the finding of empty pupal cases on March 24 indicated that moths had issued during the winter. The winter was mild and the grass remained green until frosted in early February. While we are not positive that all the larvae and pupae observed in this patch of grass were of *Diatraea saccharalis*, there seems little doubt of this, since all of 35 moths reared from larvae and pupae collected on the above mentioned dates have been identified by Doctor Dyar as belonging to this species.

Larvae of *Diatraea saccharalis* were common in patches of *Panicum gymnocarpon* and *Panicum dichotomiflorum* at Baton Rouge during October, 1922, and were taken from Johnson grass, *Holcus halepensis*, on November 8. From collections of larvae taken from stalks of broom

sedge, *Andropogon glomeratus* and *Andropogon virginicus*, at Baton Rouge during the winter only one adult of *Diatraea saccharalis* issued, while 35 moths of *Platytes densellus* Zell. were obtained. *Diatraea saccharalis* and *Diatraea evanescens* Dyar were found infesting stems of *Paspalum larrañagae* at Elm Park, La., during the summer of 1923.

As regards the occurrence of *Diatraea saccharalis* in rice it is of interest to note that from larvae collected from stems of volunteer rice at Baton Rouge on Janurary 3, 1923, 16 adults were obtained, whereas only one moth of the so-called "rice stalk-borer," *Chilo plejadellus* Zinck., issued.

From larvae of *Diatraea saccharalis* collected from grasses in January, 1923, and placed in outdoor cages at Baton Rouge 42 moths issued. The first appeared on March 22 and the last on May 16. From larvae collected during October and November, 1922, and March, 1923, and placed with food in jars in a well ventilated insectary, 21 moths developed. The first issued on April 7 and the last on May 17. There appeared to be no day or succession of days when the moths issued in greatest numbers. From 3 pupae taken in the field on January 13, 1923, moths issued in the insectary on January 20, January 31, and February 13.

Some of the grasses in which *Diatraea saccharalis* has been found to breed grow abundantly in areas where the borer has caused so much damage to corn in the past few years. It seems certain that, in the summer, after the corn becomes dry and loses its attractiveness for the borer, the moths fly to certain large-stemmed grasses and there deposit eggs and in the Spring moths that issue from grasses fly to the attractive young corn and lay eggs thereon. We should, therefore, expect a decrease in infestation by the borer in corn if the grass areas in which the pest passes the winter were eliminated or the stages present in these grasses destroyed during the winter, although more definite information, especially on the flight of the moth, should be obtained before recommending such practice as a method of control.

In Bulletin No. 746 of the U. S. Department of Agriculture Messrs. Holloway and Loftin state, with respect to *Diatraea saccharalis* as a pest of sugar cane, that "the number of food plants, some of which grow wild about plantations, makes the species more difficult to control than if it were limited to corn and sugar cane, the larvae being able to grow to maturity on wild grasses and the adults migrating to the corn and cane fields." Our observations indicate that the question of wild grasses, because of their usually being more abundant, is of more importance in connection with borer injury to corn outside of the sections where sugar cane is the principal crop than it is in these sections.

THE USE OF SKIM MILK IN THE PREPARATION OF CERTAIN SPRAY MATERIALS

By R. H. Robinson, *Chemist, Oregon Experiment Station*

Abstract

The advantages of using skim milk or milk powder in the preparation of certain sprays are discussed. A method is outlined for the use of milk in preparing a substitute for the different sulfur sprays used as summer fungicides. A mineral oil emulsion that may be prepared by using skim milk, and hydrated lime as an emulsifier is described. The use of skim milk, any of the condensed milks, or milk powder as a spreader is emphasized. These products will improve the spreading properties of the spray as well as calcium caseinate, and at a much lower cost.

The important requirements of a spray material are effectiveness without danger of injury to the plant or foliage, low initial cost, simplicity of preparation and facility of handling. Skim milk or the dried product is available at a reasonable cost in all sections of the country, and if utilized as a reagent for the preparation of certain sprays less labor will be involved and costs will be reduced. Investigations pertaining to the relation of surface tension of numerous substances to the spreading qualities of these materials disclosed the fact that milk, either the whole or the skimmed product, has a very low surface tension. This low surface tension of milk, even when very dilute, suggested its use in the preparation of substitutes for the sulfur sprays. Laboratory experiments confirmed the belief that the spray materials described below may be prepared with the aid of milk and substituted advantageously for those now in common use. It is the purpose of this paper, therefore, to report briefly the results of the laboratory observations.

Milk as a Wetting Agent For Lime And Sulfur. It is generally conceded that the various sulfur sprays used as summer fungicides are troublesome to prepare and disagreeable to apply. If lime sulfur is not used the more expensive commercial preparation must be obtained. If the spray is to be applied to tender foliage such as the peach tree, the self-boiled lime-sulfur must be home prepared. Often times this product is unsatisfactory due to the low grade materials used or to faulty manipulation of the method whereby the reaction is permitted to continue to the point where polysulfides of sulfur are formed. This form of sulfur subsequently may cause foliage burn.

The element sulfur is the active fungicidal ingredient in this class of sprays. Since powdered sulfur cannot be brought into water suspension easily, chemical or physical reactions are necessary to facilitate mixing with water. The peculiar physico-chemical properties of milk makes it especially well adapted for wetting finely ground sulfur after which it

may be introduced into the spray tank. Without reporting in detail the laboratory experiments a formula is given showing the amounts of ingredients that may be used to duplicate the proportions used in self-boiled lime-sulfur.

Sulfur, superfine flour	8 pounds
Hydrated Lime	4 pounds
Skim milk	2 quarts
Water to make	50 gallons

PREPARATION. The proper amounts of sulfur and hydrated lime are mixed together. An equal amount of water is added to the milk. This is then poured onto the sulfur and hydrated lime mixture, stirring meanwhile until a smooth paste is formed, adding more water as needed. After stirring to a creamy consistency several gallons of water are added, stirred well, and then poured through a strainer into the spray tank. Finally the required amount of water is added and the spray is ready for application.

The only precaution to observe is to use the best superfine sulfur or a form similar to that employed in dusting sulfurs. The amount of milk advised in the formula may be reduced by one-half, but the larger quantity is recommended in order to improve the spreading property of the spray. Other forms of milk may be substituted for the skim milk, such as whole milk, condensed whole or skim milk, or any of the milk powders. The amount of condensed milk found satisfactory is about one-fourth of the amount given in the formula; the dried product should be used at the rate of 2.5 ounces to the quart, or 5 ounces for the above formula. Slightly sour milk also may be used, provided it is first neutralized with a little hydrated lime.

Except when the above formula is to be applied to tender foliage there is no advantage in using so much hydrated lime. One-half pound of hydrated lime in the above formula should be sufficient to prevent any tendency to burn on foliage where summer strength lime-sulfur is used. The milk wets the sulfur as easily with .5 pound of hydrated lime as with 4 pounds of the lime.

The New Jersey Experiment Station[1] has carried on experiments with their "Dry Mix" sulfur-hydrated-lime-calcium-caseinate mixture, and has obtained better results in field tests than with any other sulfur spray. Equally good results should be obtained with the above formula where milk is used. It should likewise give as good or better results than are obtained with the commercial wettable sulfurs or the atomic-sulfurs.

[1]New Jersey Experiment Station Bulletin 379.

MILK AS AN EMULSIFIER OF MINERAL OIL. The standard dormant spray, lime sulfur, has failed to give satisfactory control of severe cases of scale in different parts of the country, while experimental tests have shown that the miscible oils and the home made fish-oil emulsions have given excellent results. Accordingly, the demand for oil emulsions has increased. Yothers[2] has outlined a method for the home preparation of engine oil emulsions by means of potash fish-oil soap. This method, however, involves considerable labor and the time necessary to prepare it is usually not available when the spray must be applied. Burroughs and Grube[3], improving upon the suggestions of Pickering[4], have developed several excellent methods by which different materials may be used to emulsify mineral oils. As these are prepared without the aid of heat they are referred to as "cold" emulsions. The procedures are short, and if care is exercised good emulsions may be obtained

As a water soluble colloid having a low surface tension and a low interfacial tension to mineral oil, milk should be an excellent emulsifier for this class of oils. Laboratory observations made of many varied combinations indicate that the following formula will give good results.

Mineral oil	4 gallons
Water	1.5 gallon
Milk	1.5 quarts
Hydrated lime	2 ounces

PREPARATION. To make the emulsion the oil is introduced into a half barrel or other suitable container. The milk is added to the water and the hydrated lime or slaked quick-lime stirred in the diluted milk This is then poured into the oil, the mixture pumped back into itself for a minute and finally pumped into another container, using as high a pressure as possible, and with the opening in the nozzle reduced until a fine spray is obtained. It should then be pumped back again to give best results.

It is important to maintain as high a pressure as the spray pump can deliver in order to produce a smooth emulsion. A pressure of 200 pounds or more is desirable. A bucket pump may be used but the higher pressure pump is advised.

Hydrated lime is used to neutralize the acid reaction of the milk and to dissolve the casein. Sodium or potassium hydroxide or sodium carbonate may be substituted for the lime, but the latter is preferable, es-

[2]U. S. D. A. Clip Sheet 193, 1922.
[3]Journ. Econ. Entomology, V. 16, No. 6, 1923.
[4]Journ. of Chem. Society, V. 91, 1907.

pecially if hard water is used. It may be necessary to use more lime than advised above if the water is very hard. Whole milk or milk powders may be substituted for skim milk. The dried milk should be used at the rate of 2.5 ounces for each quart of milk necessary.

Several grades of mineral or lubricating oil were used and no difficulty was experienced in obtaining good emulsions with any of them. The so-called red-engine oil is recommended mainly on account of its low cost. The light or medium grade will give best results.

Burroughs and Grube[4] used commercial calcium caseinate, which is a mechanical mixture of about one part casein and two parts hydrated lime, as an emulsifier with excellent results, but were not so successful with milk. If, however, they had first added an excess of lime to the milk before using, they would not have experienced any difficulty. In fact, the milk emulsified easily a waste, crank-case oil but it was impossible to emulsify it with calcium caseinate. After the addition, however, of a small amount of commercial cresylic acid to the dissolved casein a good emulsion was obtained.

It was observed that under certain conditions a water-in-oil emulsion was formed instead of the oil-in-water emulsion which may be diluted with water without destroying the emulsion. This often happens when the proportion of water to oil is reduced. In order to facilitate the preparation of emulsions various materials were added to the emulsifiers to augment, if possible, their emulsification powers. Among the materials that apparently improved the emulsifying powers of milk and calcium caseinate were commercial cresylic acid, sheep dip, beechwood creosote, and creosote oil. It is recommended that about an ounce of commercial cresylic acid be added to the water in the formula given above.

The Use of Skim Milk as a Spreader. The work by Lovett[5] on casein as a spreader suggested the possibilities of using milk as a substitute. Since casein is prepared from milk it is natural to expect that the latter likewise would have good spreading properties. Observations, however, made by spraying lead arsenate in diluted milk suspension, on apples and various leaves showed that there was no appreciable spreading. Instead the spray assumed the droplet form on the surface similar to water. Later, in a study of the surface tension of various spreader materials, milk showed low values indicative of a good spreader. Further study showed that very fresh milk would spread well on all surfaces on which calcium caseinate would spread, but after a slight de-

[5]Ore. Experiment Station Bul. 169, 1920.

velopment of acidity the spreading properties were destroyed. Neutralization by lime or other alkali restores its spreading propreties. Fresh milk normally is slightly acid, and under favorable temperature conditions rapidly develops higher acidity. Under comparatively low acid concentration the milk proteins are partially coagulated, thus destroying the spreading properties of the milk. By adding an excess of an alkali the proteins are again brought into colloidal solution and functions as a spreader. The commercial calcium caseinate is simply a mixture of hydrated lime and casein that has been precipitated from milk by the addition of a small amount of acid. When water is added to the mixture the calcium hydroxide brings the casein into colloidal solution which acts as a spreader.

The amount of milk that should be used to give good spreading of a certain spray depends upon the kind and the age of the surface to be covered. Manufacturers of casein spreaders recommend the minimum amount that will be most satisfactory under most conditions. This is oftentimes in excess and therefore a waste. Laboratory observations indicate that 3 quarts of skim milk or 7 ounces of skim milk powder to 100 gallons of spray is an average amount, and about half that amount the minimum that should be used. Two to eight ounces of hydrated lime, depending upon the spray and the age of the milk, should be added to the latter. For example, 2 ounces is sufficient for fresh milk as a spreader for lead arsenate, while 8 ounces should be used with sour milk or with lead arsenate—lime sulfur combination spray. The milk is then introduced into the spray tank nearly filled with water. Finally the spray material itself is added.

Leaves sprayed in the laboratory with lead arsenate and determinations made for the amount of arsenic that adhered showed no differences between milk or milk powder used as a spreader and calcium caseinate. Although it is generally recognized that calcium caseinate improves the spreading of various sprays, its use is limited on account of the high cost of the commercial product. Skim milk or skim milk powder will give equally good spreading if used in proper amounts, and may be obtained for less than one-third the cost of calcium caseinate.

THE STRIPED GRASS LOOPER, *MOCIS REPANDA*[1] FAB., IN TEXAS

By R. A. VICKERY, *Bureau of Entomology, U. S. Department of Agriculture*

ABSTRACT

The striped grass looper (*Mocis repanda* Fab.) which has long been known as a serious pest of crops in Tropical America is occasionally injurious in Southern Texas. It was observed at Brownsville injuring Bermuda grass and sugar-cane in 1910, and destroying pasture grasses in 1916.

In addition to corn, sugar-cane, and Bermuda grass, the larvae fed on the following grasses: *Cenchrus viridis* Spreng., *Trichloris pluriflora* Fourn., *Eriochloa punctata* (L) Hamil., *Leptochloa nealleyi* Vasey, and *Panicum fasciculatum* Sw. The latter species appeared to be the favorite host plant.

Although the striped grass looper (*Mocis repanda*) has not been recorded previously as injurious in the United States it has long been known in Tropical America. It has been recorded as a serious pest of crops in the West Indies, in British Guiana and in Brazil. Bodkin, (9)[2] the British Government entomologist describing the damage done by this insect in British Guiana says: "On sugar-cane, rice, Paragrass and other grasses throughout the coast lands of the colony this moth may be found throughout the year and at certain periods, particularly on the occurrence of rain after prolonged drought, it appears in vast hordes completely destroying whole areas of the previously mentioned crops."

INJURIOUS OCCURRENCE IN THE UNITED STATES

The full grown larva is about 1–¾ inches long and $\frac{3}{16}$ inch wide, and is easily recognized by its slender cylindrical body, conspicuous brown stripes, and its habit of looping the body when in motion. In general habits these larvae resemble army-worms. They may occur in great numbers in a small area and completely defoliate the wild and cultivated grasses upon which they feed, leaving only the stems of small grasses and the stems and midribs of large grasses such as sugar-cane. When the food plants are destroyed the larvae migrate. The larval stages have been described by Dr. H. G. Dyar (1).

The larvae of *Mocis repanda* were observed by the writer first at Brownsville Tex., on October 18, 1910. They were feeding on Bermuda grass in company with army worms (*Cirphis unipuncta* Haw.). One larva was found feeding on sugar-cane, also in company with army worms. The larvae destroyed considerable Bermuda grass and damaged

[1]Lepidoptera, Noctuidae.
[2]Reference is made by number to "Literature cited."

the sugar-cane in the experimental plots of the "South Texas Gardens."[3] No further observations were made during that year.

On January 25, 1913 Mr. E. G. Smythe collected three of these larvae from an undetermined species of grass; and on July 5, 1914 the writer collected two larvae from Bermuda grass.

This insect was not observed again until September 21, 1916 when a report reached the laboratory that caterpillars were destroying the grass in a pasture. Inspection developed that the grass was practically destroyed in a field of about 300 acres. The most common grass was *Panicum fasciculatum* associated with other nearly mature grasses and weeds. There were larvae of various stages on the grass stems and on the ground, and they had eaten the leaves off most of the grass. There were many cocoons attached to the stems of the grasses and to weeds and many adults flew up as we walked through the field. Three species of caterpillars, *Cirphis unipuncta* Haw., *C. latiuscula* H. Schr., and *Mocis repanda* were located working damage in this field. The latter species was most numerous. There also were a number of *Laphygma frugiperda* S. & A., and a few Prodenia sp., the latter feeding on the weeds.

The larvae were found in another field about three miles from this one but no other extensive injury was located.

During another field trip on September 26, these larvae were found feeding on four species of grasses, *Cenchrus viridis*, *Trichloris pluriflora*, *Eriochloa punctata*, and *Panicum fasciculatum*, but they were most common on the latter species. The larvae did not appear to be damaging cultivated crops and they were not observed again doing damage to grasses, which was contrary to expectations, as the large number of moths found in the fields would indicate that all grass crops would be seriously attacked.

During the month of October the moths were observed to be very numerous flying around every where in the grass and weeds. On October 15 they were found to be rather numerous on the sandy ridges near the coast. They were also observed on the walls of public buildings in Brownsville at night between October 13 and November 6. Mr. T. S. Wilson collected a male adult at night November 26 and another from grass November 29, which were the last moths observed.

Food Plants

The moths of this species seem to prefer fields of grass of the genus

[3] A plant introduction garden maintained for several years by the United States Department of Agriculture on the Fort Brown Reservation, located on the Rio Grande river adjacent to Brownsville.

Panicum for oviposition but they also attack other wild or cultivated grasses and the larvae may migrate to cultivated plants from fields of grass. At Brownsville we observed the larvae feeding on corn, sugar-cane, and Bermuda grass (*Cynodon dactylon* (L) Pers.) in 1910, and on five species of grasses—*Cenchrus viridis* Spreng., *Trichloris pluriflora* Fourn., *Eriochloa punctata* (L) Hamil., *Leptochloa nealleyi* Vasey, and *Panicum fasciculatum* Sw.,—in 1916.

The larvae of Mocis repanda have been recorded as destroying Para-grass (*Panicum muticum* Forsk.), Guinea-grass (*Panicum maximum* Jacq.), and sugar-cane, in (5) Trinidad; sugar-cane, rice, Para-grass and other grasses in (9) British Guiana; Para-grass and Guinea-grass in (2) Barbadoes; Guinea-grass, alfalfa, sugar-cane, and millet in (10) Brazil; and sugar-cane in (6, 7, 8) Porto Rico.

Life History

No very extensive work has been done on the life history of this species. As it is a native of the tropics and adapted to feed on grasses, which may be found in a green state throughout the year in tropical countries and along the gulf coast of the United States, it does not hibernate and probably could not pass the winter north of the gulf coast section of this country. It resembles *Laphygma frugiperda* S & A, in this respect, and like Laphygma it also passes through many generations during the year.

During the fall of 1916 we carried on a few experiments in the laboratory at Brownsville to learn something of its life history. The entire life cycle from the time the eggs were laid to the time the adults appeared occupied 36 days during October and November at an average daily mean temperature of 76 degrees F.

The Egg Stage

Moths were placed in a large lantern globe and fed on a thin sugar syrup. Strips of paper and leaves of corn were placed in this cage, and the moths laid a few eggs on the corn leaves but they laid a larger number on the walls of the lantern globe and on the paper. The eggs were laid singly. Mr. T. S. Wilson worked out the egg stage during the month of November as given in Table I.

The Larva Stage

Eggs of *Mocis repanda* hatched October 9, 1916 and the larvae were reared in tin boxes. It was possible to rear many larvae in a single cage as they are not cannibalistic but it was more convenient to isolate the

TABLE I. EGG STAGE OF MOCIS REPANDA, BROWNSVILLE, TEX., 1916

Eggs laid	Eggs hatched	Number of days	Average Temperature Degrees F.
1916	1916		
Between 5 p. m.[4] Nov. 23 and 9 a. m. Nov. 24	December 1	7	69
Between 5 p. m. Nov. 24 and 9 a. m. Nov. 25	December 1	6	70
Between 9 a. m. Nov. 26 and 9 a. m. Nov. 27	December 2	5	72.5

larger larvae in tin boxes, where they were fed on corn leaves. Pupation began October 30 which would make the length of the entire larval stage from egg to pupa 21 days at the temperature of the laboratory or an average daily mean temperature of 76–½° F. When preparing to pupate the larvae fasten together leaves to form a cocoon, using only enough silk to fasten the leaves and spin a thin protection around the larva. The prepupal period occupied from 24 to 36 hours.

THE PUPA STAGE

The pupation period for 12 pupae was observed in the laboratory from October 23, to November 13, 1910. The number of days varied from 10 to 14, the average being 12. The temperature was not recorded. A few larvae pupated October 30, 1916, and the adults emerged November 9. The time was 10 days at an average daily mean temperature of 77° F. The pupation records of eight larvae which pupated during the latter part of September are given in Table II.

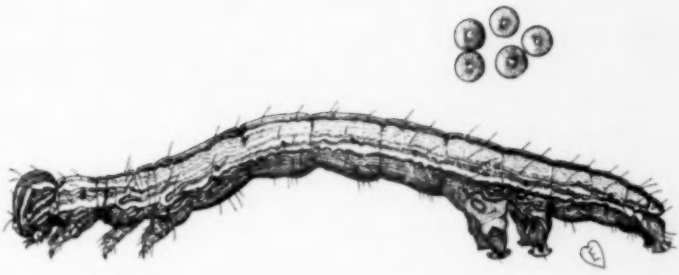
TABLE II. PUPAL PERIOD OF MOCIS REPANDA, BROWNSVILLE, TEX., 1916

Number of larvae	Pupated	Moth emerged	Number of days	Average temperature degrees F.
	1916	1916		
2	Sept. 29	Oct. 7	8	79
1	Sept. 25	Oct. 2	7	81
1	Sept. 25	Oct. 3	8	81
4	Sept. 25	Oct. 4	9	81

NATURAL ENEMIES

No parasites of *Mocis repanda* were reared during our observations on this species at Brownsville, although large numbers of larvae and pupae were collected for this purpose, 161 larvae being taken in one collection. Mr. T. S. Wilson collected a small larva feeding on the grass *Leptochloa nealleyi* Vasey on November 22, which had two Euplectrus

[4]All references to clock time refer to "Standard Time."



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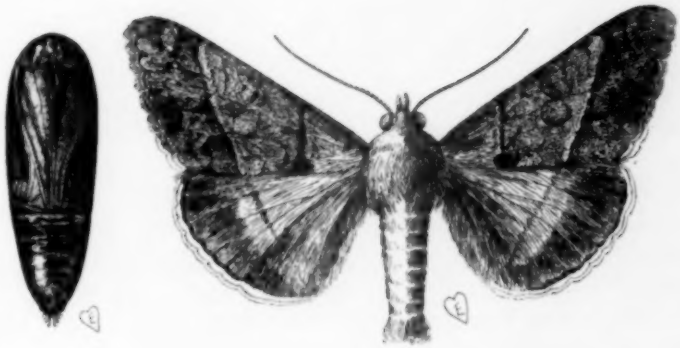

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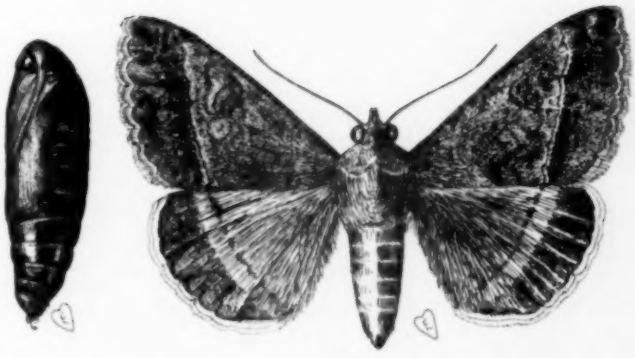

3

1.—Side view of larva; 5 eggs above; all enlarged.
2.—Male, also ventral aspect of a pupa.
3.—Female, also lateral aspect of a pupa.

larvae attached to it, but we were not successful in rearing the adults. This was the only case of parasitism observed.

The following natural enemies have been recorded in the literature: In Trinidad, Urich (5) mentions blackbirds (*Quiscalus crassirostris*, *Crotophaga ani*) and parasitic flies. In British Guiana, Bodkin (9) records the Demerara robin (*Leistes guianensis*), the ladybird beetle (*Megilla maculata*), and a bacterial disease. In Porto Rico, Van Dine (7) records a carabid beetle (*Calosoma alternans* Fabr.), blackbirds (*Crotophaga ani*, *Holoquiscalus brachipterus*) and a tachinid fly (*Linnaemya fulvicauda* Walton). In Brazil, Hempel (4) records an undetermined tachinid, and a hymenopterus parasite in small numbers, and several species of birds.

Control Measures

No experiments were tried with control measures at Brownsville, but measures similar to those used for army worms would probably be useful.

In British Guiana, Bodkin (9) advises burning of badly infested fields of grass when the insect is in the pupa stage in order to prevent further infestations. For infested rice in the nursery beds he recommends flooding. For sugar-cane he recommends the use of arsenate of lead although the usual method employed is hand picking the larvae. In Brazil, Hempel (4) recommends the burning of infested grass and the use of furrows to confine the migrating larvae.

Literature Cited

There is an extensive literature on this species including about 22 titles of economic importance and about 20 titles in the faunistic and systematic literature. The articles referred to in this paper are listed below.

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THE SPOTTED CUTWORM, *AGROTIS C-NIGRUM* (L), A CRANBERRY PEST[1]

By H. J. Franklin and D. S. Lacroix

During the summer of 1923, severe outbreaks of the Spotted Cutworm, *Agrotis c-nigrum* (L.), occurred on several cranberry bogs in southeastern Massachusetts. The infestations developed quickly and most of the crop on the infested areas was destroyed before treatment could be applied to advantage. The activities of this pest became evident almost simultaneously on thirteen widely separated bogs in the towns of Kingston, Middleboro, Rochester, Carver, Wareham, Barnstable, Harwich, Orleans, and Chatham, during the latter part of July. It was estimated that the total area infested was about 200 acres and that the possible loss was 10,000 barrels of berries, representing a money loss of $60,000.

The first indication of the work of this insect was the sudden disappearance of the cranberry blossoms. Also, many fallen green leaves appeared in the bog ditches.

The larvae, which were nearly all full grown by the last week in July, were found during the day among the litter of dead leaves on the bog bottom. At night they climbed the cranberry uprights and fed by cutting off the flowers at the distal end of the pedicel and dropping them. Later, they cut off the small berries in the same way. They also cut off many leaves, apparently devouring but little of them. This accounts for the fallen green leaves seen first along the ditches and later everywhere under seriously infested vines. The most severe infestations so defoliated small areas of bog that the bare uprights gave some of the vines a brown tinge when viewed from a distance. When the berries had attained some size, the worms ate into many of them more or less, often devouring the interior and leaving only the outer portion.

Of the two most widely grown cranberry varieties, the Early Black and the Howes, the latter generally was preferred by the larvae. On bogs having these varieties on adjoining sections, the infestation often seemed to stop where the Early Black sections began.

[1]The observations reported here were made by the authors in research conducted by the Massacusetts Agricultural Experiment Station.

In Massachusetts most cranberry bogs are covered with water during the winter. Sometimes this winter flood is let off in early April and sometimes it is held until late May or early June. On ten of the infested bogs, comprising a total of 165 acres on which the crop was a total loss, the winter flowage had been let off between May 28 and June 5; one infested bog, on which an area of only 5 acres was seriously affected, had been drained of winter flowage in April; one bog of about ten acres had the winter water let off in April, was flooded again May 16, and finally drained June 1st. One bog was drained of its winter flowage in April but water backed in onto the lower part from an adjoining bog, the latter having been held under water until May 28. A heavy infestation appeared on the bog drained May 28 and also on the low part of the adjoining bog which had been drained in April. These facts suggest that damp soil in very late May and early June invites infestations of this insect, possibly because the female moths prefer to lay their eggs in damp or slimy earth. They also show that the pest does not attack cranberry bogs much unless the winter water is held until late May.

About 700 larvae were collected for rearing. These worms were nearly all full grown, and pupating began almost at once, continuing from about August 1 to August 25. The greatest number of larvae pupated the second week in August. The time spent as a pupa averaged 19 days, being never less than 17 nor more than 24 days. Pupation took place in the rearing cans about three inches below the surface of the sand. On the bogs, pupae were found at depths of one to four inches.

Adults in the rearing cans began to emerge August 20 and continued coming out until nearly the middle of September, the height of the emerging period being through the first week in September. The moths died rapidly without laying eggs. One female was kept alive much longer than the others by feeding her with a sugar solution, and she deposited several eggs on sand and on the sugar container. These eggs were spherical, about .75 mm. in diameter and fluted. They were laid September 15 and hatched September 29. The young larvae would not feed on clover, newly sprouted corn, ferns or cranberry leaves and they died in the first instar.

No adults were seen on any of the infested bogs.

Over 70 per cent of the worms gathered for rearing bore eggs of dipterous parasites, as many as eleven being found on some. In most cases the host failed to reach pupation. Records were kept of all the parasites that emerged. The Red-tailed Tachina Fly, *Winthemia quadripustulata* Fabr., was the most abundant, about 65 per cent of the

worms being parasitized by this fly alone. Other parasites reared are *Phorocera claripennis* Macq. (Dipt.), *Amblyteles seminiger* Cress. (Hym.), and *Euplectrus bicolor* Swederus (Hym.). The last named was identified by Mr. A. B. Gahan of the Bureau of Entomology, and Dr. L. O. Howard informs us that it is an important parasite of cutworms in Europe. This is probably its first recorded appearance in North America.

Agrotis ypsilon Rott., the Greasy Cutworm, was found occasionally along with the Spotted Cutworm, but not in numbers to do appreciable harm. When placed in rearing cans with *A. c-nigrum*, the Greasy Cutworm larvae proved very carnivorous, rapidly devouring the Spotted Cutworm larvae.

Agrotis c-nigrum has been known to injure limited cranberry areas occasionally in previous years, the outbreak in every case observed being on a bog on which the winter water had been held late, but no cranberry grower recalls a former instance of any such extensive injury as occurred in 1923. Evidently, this was a Spotted Cutworm year. It should be stated that, in addition to the marked activities of the pest described above, a few of the worms and scattering marks of their work on the blossoms and berries could be found on most of the Cape Cod bogs.

This is the fourth species of cutworm now known to infest cranberry bogs seriously as a result of holding the winter flood very late, the others being the Army Worm (*Cirphis unipuncta*), the Fall Army Worm (*Laphygma frugiperda*) and the Greasy Cutworm (*Agrotis ypsilon*).

A DEVICE FOR INFLATING LARVAE

By F. H. Mosher and J. E. R. Holbrook, *Gipsy Moth Laboratory, Melrose Highlands, Mass.*

Since 1911 it has fallen to the lot of some of the assistants at the Melrose Highlands Parasite Laboratory to inflate the larvae, not only of the gipsy moth and the brown-tail moth, but of many other lepidopterous larvae of native species to be used for cabinet specimens. Many of these are hosts of the parasitic and predaceous insects imported to hold the gipsy moth and the brown-tail moth in check.

With the devices first used the air pressure was obtained by a bulb pressed by the hand or by a bellows operated by the foot. The former was very tiresome and the operator had but one hand to arrange the larva and only one specimen could be inflated at a time. With the second

method the larvae were usually much distended and had a very unnatural appearance.

The amount of inflating work has increased greatly since the work was started in the spring of 1911 and the devices described here have been worked out by those having the work to do. Mr. C. B. Russell, who worked for several years in this Bureau, perfected a device by means of which compressed air can be utilized, the flow being regulated by needle valves. The tubes with the points and clips were in use on other inflating devices. The glass tube back of the clips so that a tip can be slipped off and another placed on after a specimen has been put in place, was designed by Mr. Holbrook.

A great demand for inflated larvae of the gipsy moth and brown-tail moth was the cause of this apparatus being assembled at the Gipsy Moth Laboratory, Melrose Highlands, Mass. This has eliminated some of the tedious operations experienced by those engaged at this task and made the results more satisfactory.

In the process of inflating, the two most necessary elements for good work and speed are a steady supply of air pressure and a sufficient adjustable amount of heat to meet requirements.

The apparatus and accessories being used at the Gipsy Moth Laboratory are neither complicated nor difficult to assemble. The outfit consists of two units, namely, the oven and an air pressure tank.

The oven is of ordinary galvanized iron 9″ long, 7″ deep and 11½″ high. Six inches from the bottom a horizontal metal partition divides this space into two chambers, an upper and lower. The backs of both chambers are closed, the lower with metal and the upper with glass to admit light. The fronts remain open thus permitting the operator to inspect the gas burner in the lower and attend to the specimens in the upper chamber. Attached to the bottom of the front of the upper chamber are 2 pairs of metal clips that are used for holding the subjects over the heat. These clips are made of a ½″springy metal 3½″ tall and are spaced 3¼″ between pairs.

The air pressure reservoir is a Galvanized Expansion Tank ordinarily used in buildings heated by a hot water system. The pressure is forced into the tank with a bicycle pump through a valve stem placed in a ½″ opening near the base.

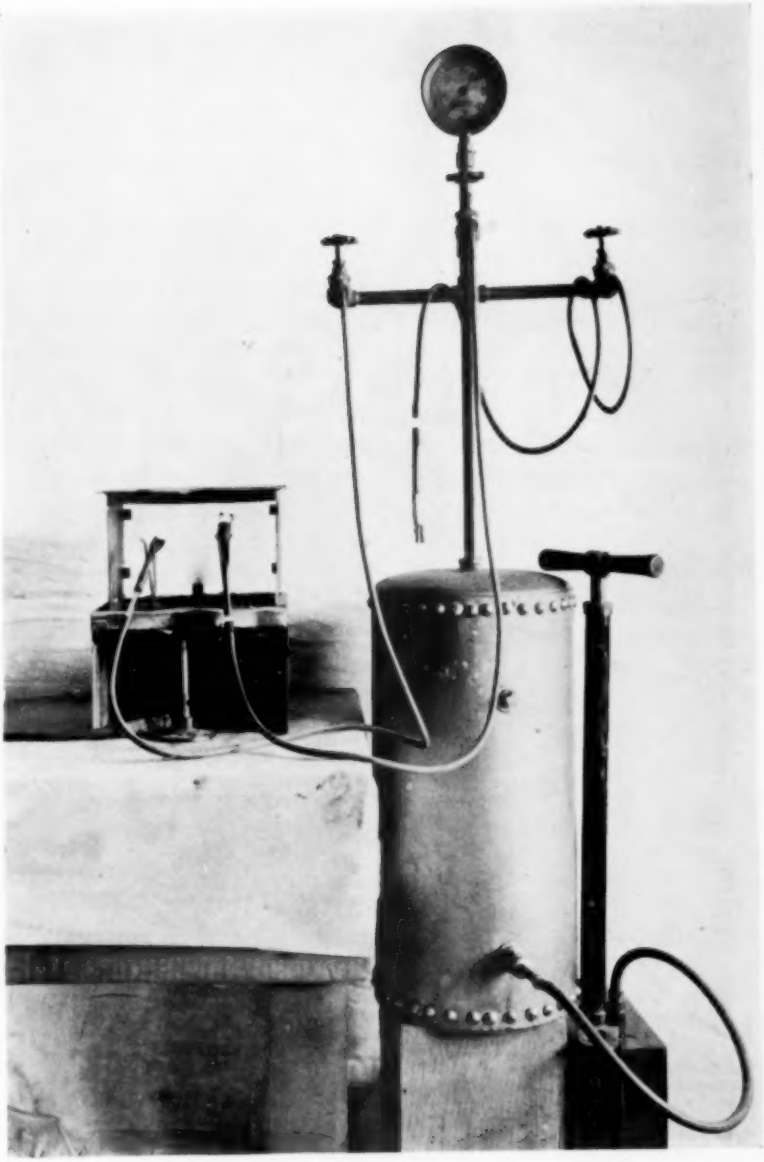
The tank was provided with a number of openings, some not being needed for our purpose. These extra holes were sealed with plugs such as are commonly used on steam boilers.

The various materials used in constructing the apparatus can be secured from firms dealing in plumbing supplies, and are as follows:

1 Galvanized Expansion Tank—20 inches high, 10 inches diameter, 8 gallons capacity.
1½″ x ⅜″ brass reducing coupling
1½″ close nipple
1 bicycle pump
2 1″ plugs
1 ½″ plug
1 1″ x ½″ bushing
1 pc. ½″ pipe, 13″ long
1 ½″ x ⅜″ cross
2 pieces ⅜″ pipe, 5¼″ long
2 ⅜″ elbows
1 ½″ short space, 1¾″ long
1 Reducing Tee, ½″ x ⅜″ x ⅜″
1 ⅜″ Nipple, 3¼″ long
1 ⅜″ x ¼″ reducing coupling
1 3½″ Pressure gauge, 30 lbs. capacity
3 No. 82 Brunner Needle Valves, with No. 81 Swivel hose connections
3 3 ft. pieces ⅛″ hose rubber tubing
3 ⅜″ leather washers

The automobile tire valve is soldered into the ½″ x ⅜″ brass reducing coupling, attached to the ½″ close nipple and placed in the lower hole intended for a water gauge glass. The upper gauge glass hole is plugged with a ½″ plug. A 1″ hole in the bottom and another in the side of tank are plugged with 1″ plugs. The bushing 1″ x ½″ is placed in the opening on the top surface, from which a ½″ pipe 13″ long leads to the ½″ x ⅜″ reducing cross. Each piece of the ⅜″ pipe 5¼″ long is set into the sides of the cross, being fitted with a ⅜″ elbow into which a Needle Valve is connected. The ½″ short space 1¾″ long continues from the top of the cross to the reducing tee ½″ x ⅜″ x ⅜″ which is fitted, off the run, with the remaining Needle Valve. The ⅜″ nipple 3¼″ long is continued from the top of reducing tee to the ⅜″ x ¼″ reducing coupling into which the pressure gauge is fitted. One end of each piece of the ⅛″ rubber tube is placed in the hole of a ⅜″ leather washer and worked onto the ¼″ hose nipple, making a tight connection. The end of a ¼″ glass tube 4″ long is placed in the extreme end of each rubber tube, the free end of glass is used as a connection for attaching the inflating tips.

The inflating tips are made up of ¼″ glass tubing drawn to various degrees of fineness, being 3″ long when finished. Two inches of the proper end is inserted in a ⅛″ rubber tube 5″ long; 2″ of 2 thin strips of copper



Device for inflating larvae

¼″ wide and ¾″ long are bound on opposite one another with an adhesive tape having only one side treated. A portion of these protruding ends are bent at a right angle towards the glass tip and adjusted so that the lower strip will grip the caterpillar slightly ahead of the anal prolegs. The upper strip is not used except in cases when the lower one is not holding well. An elastic band is slipped around these holders after the caterpillar is arranged and the upper strip bent upward enough so it does not interfere. These tips are placed in the clips in the oven and the drying proceeds. Extra tips should be provided so that a specimen can be prepared while the others are in the oven.

This device has relieved much of the monotony of this work and greatly increased the quality as well as the quantity of the specimens. An operator with a little experience can easily inflate fifty large larvae the size of full grown gipsy moth larvae in a day and many more than that if the larvae are smaller or thin skinned.

The air pressure should not exceed 15 pounds and 10 pounds is better. Over 15 extends the specimen too much and gives it an unnatural appearance. The larvae were placed in a cyanide bottle for a few minutes before they were rolled and inflated.

First stage larvae bothered considerably at first as they were so small it was difficult to get a point fine enough to inflate them. It was found that by placing these small larvae on the top of the oven and keeping them moving, in a short time the air within the body would expand and cause them to "pop." These "popped" specimens were then mounted on card points. A few of these will "pop" through the side and spoil the specimen.

The cost of this device was a little less than twenty dollars (prewar prices) and will soon pay for itself in the greater number of specimens inflated.

NOTES ON THE PEAR MIDGE (*CONTARINIA PYRIVORA*).

By Lawrence Paul Wehrle

During the summer of 1922, while engaged in a study of the pear midge (*Contarinia pyrivora* Riley) the writer made some observations which it seems desirable to record at this time.

The pear midge first attracted special attention in Connecticut in 1884 and seems to have been introduced on pear stocks from France in 1877. Although this insect was probably described by Meigen as *Diplosis nigra* the type specimens had been lost and Riley in 1885

redescribed the species. He proposed the name *pyrivora* to be used if *nigra* is really a lost species or if the species in America should prove to be different from that in Europe. The name *pyrivora* is now used to designate the species in Europe and America.

There is some infestation by the pear midge at Ithaca, New York and on May 26, 1922, several badly infested trees were found. At that time the larvae were nearly all grown and some of them had already left the fruits. There were a good many fruits on the ground with larvae in them and many of the fruits remaining on the trees were also infested. When infested the fruits have black spots and holes on the outside and become hollow and discolored on the inside and are soft. Some of the fruits also become somewhat elongated and occasionally are found to be entirely black and decayed.

Pears were collected from the infested trees and from the ground under the trees. The larvae were found to be very numerous in the fruits. Two average sized selected fruits collected May 17 and examined May 18 yielded 18 and 37 larvae respectively.

On the evening of May 26, 1922 over a hundred pear midge larvae were obtained from the infested fruits collected that day and were placed in individual vials and salve boxes. The following interesting characteristic was noted. When crawling along or lying on a horizontal surface the larva would draw up its anterior and posterior ends close together until its body was in the form of an arch. Then it would let go like a spring and the larva would throw itself quite a distance in this way. One larva jumped one and one-fourth inches in one jump and another jumped one and one-half inches in one jump. A third larva jumped two and one-half inches in one jump and in a little while this same third larva jumped two inches in another jump. A fourth larva was noted to jump to the height of one and one-fourth inches. This jumping characteristic has been reported by other writers.

On August 30, 1922, soil was collected from under a pear tree the fruit of which was infested in the spring. Some of this soil was examined and four cocoons of the pear midge were found. It is evident that the cocoons are formed from one-half to one inch beneath the surface as only the very thin top layer of soil was collected for examination. The cocoons were pale colored and eliptical in shape. The cocoons were examined and it was found that the insect was still in the larval stage.

Time of Pupation:—There seems to be some uncertainty among writers as to the time of pupation of the pear midge.

The specimens on which this study is based were collected May 26,

1922. On the same day some of the larvae were put on moist soil in individual vials and others were placed on moist soil in salve boxes. On June 10 the larvae in the salve boxes were removed to moist soil in petri dishes. Later these larvae were also transferred to moist soil in individual vials. The vials were kept in salve boxes in an out-door cage and were all later numbered. An attempt was made to keep the soil in a uniform moist condition and observations were made on the specimens throughout the summer. Pupation was found to begin in very late August or early September and continued throughout September and early October. One specimen was observed to be in the process of pupation as late as November 27, 1922.

TABLE 1. TIME OF PUPATION, 1922

Specimen Number	Date Larva Collected	Date of Pupation
114	May 26	Aug. 25—Sept. 2
61	"	Sept. 2–8
62	"	" "
5	"	" "
13	"	" "
15	"	" "
19	"	" "
22	"	" "
28	"	" "
35	"	" "
41	"	" "
47	"	" "
52	"	" "
57	"	" "
112	"	" "
4	"	Sept. 9
20	"	" "
23	"	" "
53	"	" "
63	"	" "
119	"	" "
117	"	" 10
17	"	" 11
43	"	" "
65	"	" "
42	"	" 12–14
6	"	" 15
55	"	" "
58	"	" "
12	"	" 17–20
48	"	" 22

16	May	Sept. 23
115	"	" "
64	"	" 24
124	"	" "
1	"	" 24–27
30	"	" "
122	"	" "
2	"	" 28–Oct. 2
26	"	" " " "
116	"	Oct. 2–5
121	"	" 9
113	"	Nov. 27

MULLEN ROSETTES AS WINTER SHELTERS FOR INSECTS

By W. L. McAtee

The common mullen (*Verbascum thapsus*) is a biennial which passes the winter in the form of copious rosettes closely applied to the ground. The leaves are so densely wooly as to have earned for the plant such vernacular names as flannel-leaf and blanket-leaf. Their obvious suitability for sheltering hibernating insects led me to make some investigation of the matter several years ago. While no further notes have been taken, it is hoped that even these scanty data will be of some interest.

All of the examinations were made in an old field on the Maryland shore near Plummers Island, and were conducted at various dates, ranging from November 25 to April 5 in the years 1914 and 1915. An account will be given of the largest collection of insects made from a single rosette, and also a list of additional species taken on other occasions.

Insects Taken From a Single Rosette, January 25, 1914

Heteroptera

Heraeus plebejus Stal., 1.
Ptochiomera nodosa Say, 19.
Nabis sp., 1.
Lygus pratensis Linnaeus, 3.

Homoptera

Erythroneura vulnerata Fitch, 1.

Coleoptera

Stenolophus conjunctus Say, 5.
Astenus sp., 3.
Conosoma, sp., 2.
Atheta sp., 2.
Gymnetron tetrum Fabricius, 4.

Hymenoptera

Ant, 1.

Total 10 species, 42 individuals.

Other Insects Found Hibernating in Mullen Leaves

Heteroptera

Thyreocoris ater Amyot et Serville
Lygaeus kalmii Stal.
Ischnorhynchus resedae Panzer.
Geocoris uliginosus Say.
Crophius disconotus Say.
Pselliopus cinctus Fabricius.
Orius insidiosus Say.

Coleoptera.

Amara crassispina LeConte.

Casnonia pennsylvanica Linnaeus
Pinophilus latipes Gravenhorst
Languria mozardi Latreille.
Melanophthalma americana Mannerheim.
Acylomus ergoti Casey.
Calathus gregarius Deean.
Anaedus brunneus Ziegler.
Chalepus dorsalis Thunberg.
Hypera punctata Fabricius.
Chalcodermus collaris Horn.
Tyloderma foveolata Say.

Besides these adult insects, a nymph of a reduviid and of an unidentified heteropteron, two carabid larvae, some cutworms and spiders were found among the mullen leaves.

Scientific Notes

Oriental Fruit Moth. Among the interesting observations on the activities of *Laspeyresia molesta* this spring was a flight of moths on May 6. On this date, during the morning and at midday the adults were plentiful; flying about in the orchard and resting on the foliage and stems. Mating pairs were noted. Contrary to the statements in several publications on the subject the adults were very active during this bright sunny day, temperature about 82 to 85, no wind, in fact the warmest day of the spring.

A. B. CHAMPLAIN
T. L. GUYTON

Notes on the Life History of *Disonycha laevigata* Jacoby in Porto Rico. This shining green flea beetle has been known from Jamaica and Santo Domingo for some years, but was noted at Gúanica, Porto Rico in August 1921. The writer found it abundant at the College and Experiment Station grounds at Mayagüez in September 1921. A note upon its food plants, by Mr. G. N. Wolcott, Entomologist of the Insular Experiment Station at Rio Piedras, appeared in the JOURNAL OF ECONOMIC ENTOMOLOGY for October 1923.

In the college year 1922–23 Messrs. Rafael Bemúdez and Armando Arroyo and other students worked out the life history of this new pest of beets and chard in Porto Rico, also life histories of two other flea beetles, *Oedionychis cyanipennis* Fabr. and *Haltica occidentalis* Suffrian, but as neither of these latter species are pests of cultivated plants in Porto Rico, so far as known to the writer, space will be taken here to record only the notes on *Disonycha laevigata* Jac. which is a serious pest.

The adult is about 4.5 mm. long, the female being larger than the male, with glossy green elytra, which in some of the dried specimens change to deep blue. The head, thorax and abdomen are orange as are also the legs excepting the distal portions which are dark. The eyes are black and the greater portion of the antennae dark. They hop very freely and fly rapidly. During the hours of hot sunshine most of them hide on the lower surface of the leaves or in crevices.

The eggs are of a soft shade of terra cotta to grenadine red, fusiform, and beautifully fretted with minute pits in honeycomb pattern, and are either glued to the underside of leaves or deposited upon the soil near the stem of the plant. They hatched in from four to seven days, the majority of the egg clusters hatching in five days. The larva emerges from the side of the egg, near the apical end, when the other end is attached to a leaf, leaving a yellowish white chorion.

The newly hatched larva is pink with dark yellow head. The full-grown larva is light grey and about one centimeter in length. It has rows of hairs with round, semitransparent tips. If the leaves on which they are feeding are disturbed the larvae fall to the ground. The larval period lasts from 11 to 14 days. The prepupal stage lasts one day. The pupa is yellow until shortly before emerging. The pupal stage is spent underground and lasts 7 days in most cases, 6 days in one instance. The adult remains in the pupal cell a few hours until the wings are hardened, then crawls out and begins feeding on the leaves.

The total time from newly hatched egg to adult was usually 26 days. In three days more the adults were mating.

RALPH E. DANFORTH, *College of Agriculture and Mechanic Arts, Mayagüez, P. R.*

Hydrocyanic Acid Retained by Fumigated Cheese. Messrs. E. R. de Ong and C. L. Roadhouse have recently published the recommendation that cheese may be fumigated with hydrocyanic acid gas for the destruction of certain cheese pests ("Cheese Pests and Their Control," Calif. Exp. Sta. Bul. 343, May, 1922). The ability to use this gas with safety in cheese rooms without removing the cheese is much to be desired and in connection with his work with the cheese skipper (*Piophila casei* L.) the writer made several preliminary tests of the advisability of using this fumigant. He is indebted to Dr. R. E. Holm, Division of Virus-Serum Control, Bureau of Animal Industry, U. S. D. A., for the analyses of the fumigated cheese. A review of the experiments and results follows.

Oct. 10–11, 1921. Fumigating box, 100 cu. ft. Charge 4 oz. NaCN, 6 oz. H_2SO_4, 8 oz. water. Temperature at start about 55° F.; relative humidity about 80%. Exposure of cheese 10:30 A. M. to 8:45 A. M. Cheese tested: Camembert, Cheddar and Swiss, the pieces being roughly 3 x 3 x 3 inches. One side of each piece freshly cut and marked. Gas not strong when box opened. Analysis showed considerable HCN in the cheese, especially in the Camembert; least in the Cheddar. The gas in the cheese much reduced after airing for about one day.

Oct. 17–18, 1921. Fumigating box the same, but repaired to reduce leakage. Charge 2 oz. NaCN, 3 oz. H_2SO_4, 4 oz. water. Temperature about 63° F.; relative humidity 89%. Exposure of cheese 3:00 P. M. to 9:30 A. M. Gas strong when box opened. Cheese tested, same as in first trial. Analyses showed that a large amount of acid was retained, even after airing for about one day. After this airing, more acid was present in the center of the cheese than near the surface, due, probably, to slower dissipation from within.

Oct. 18–19, 1921. Fumigating box the same. Charge 1 oz. NaCN; 1½ oz. H_2SO_4, 2 oz. water. Temperature about 65° F.; relative humidity 80%. Exposure of cheese 11:00 A. M. to 10:00 A. M. Temperature steadily declined to 55° F. at end of trial. Migrant skipper larvae used as indicators of efficiency of the fumigation were killed; these were exposed in Petri dishes. Cheese aired for 24 hours before being sent to Dr. Holm's laboratory. Analyses showed that HCN was found in all the samples, but the concentration in the Cheddar amounted to a mere trace.

On account of the tenacity with which skipper larvae cling to life in the presence of hydrocyanic acid gas, especially when embedded in their food materials, the writer feels that dosages up to and including one ounce per 100 cu. ft. would be largely wasted. Cheese mites also are reported to be very resistant to this gas. It would

not be safe to assume that all cheeses in a given room were protected by an unbroken coating of paraffin, and in view of the very evident tendency of cheese to retain this poisonous acid and the fact that cheese is not usually cooked before being eaten, (a process which would be expected to aid the volatilization of the retained acid), the writer feels that until more extensive tests are made to prove otherwise, in regard to each variety of cheese, cyanide fumigation of cheese should not be recommended.

PEREZ SIMMONS, *Entomologist, Stored Product Insect Investigations,*
Bureau of Entomology, U. S. Dept. Agr.

Calcium Cyanide Dust for Rosy Apple Aphis. On June 21, 1923 eight and one-half Gravenstein and two Baldwin apple trees, twenty-five years old, were dusted between two and four P. M. with Calcium Cyanide dust (twenty-five percent calcium cyanide, seventy-five percent talc) for the control of *Aphis sorbi*. The total amount of dust used was twenty-five pounds, an average of about three pounds per tree. The tests were conducted in the A. J. Schaefer orchards situated in Ulster County near Plattekill, N. Y. The applications were made with a Dosch hand duster.

Weather conditions were almost ideal for dusting; there had been no rain for several days preceding or subsequent to the application; temperature at the time of the applications was 92° F.; relative humidity 85%; southwest winds of about three miles per hour prevailed.

The undersides of the leaves on all of the trees were heavily infested with both winged and wingless forms of *Aphis sorbi*. After each application, the trees were shaken to dislodge the insects. The following forms were caught on sheets under the trees: *Aphis sorbi*, ants, bees, rose leaf beetles. The average quantity of insects caught on one sheet measuring seven feet by three feet was upward of three cubic inches of insects.

The first examinations were made about five minutes after each application—at the time the trees were shaken. The next examinations were made about ten hours later. While a small percentage of the total catch still seemed to be alive at the time of the first examination, there was apparently no survival at the time of the second examination.

Later examinations of the trees during the season revealed no injury to either fruit or foliage as a result of the applications. At the time of the tests, the average size of the fruit was about one inch in diameter. Some of the infested leaves had already curled.

C. C. WAGONER, *Highland, N. Y.*

Note on the Squash Beetle (*Epilachna borealis* Fab.). Under the caption "Squash Pest," Mr. Wyatt W. Jones, writing in the JOURNAL OF ECONOMIC ENTOMOLOGY of February, 1924 (Vol. 17, page 176), calls attention to the occurrence of this species at Douglas, Arizona, attacking all kinds of cucurbits, including *Apondanthera undulata*. The writer received two specimens from Mr. Jones which correspond very closely to what Gorham[1] considers typical *borealis*, the only observable difference being that in the case of Mr. Jones' sending, in one specimen the elytral black dots are a little smaller and the prothorax is unspotted. In a series of a similar lot with spots a little larger, received from Mr. E. G. Smyth and collected at Guatemala City, Guatemala, in 1923, in one example the median thoracic spot is present and the others

[1]Biologia Centrali-Americana, Coleoptera, Vol. 7, p. 241, Pl. 13, Fig. 12.

are indicated. There is no reasonable doubt of the identity of this variation with the *borealis* of the North. In the Northern States the species is more brightly yellow and has larger black spots, and it is true that the Arizona specimens do have somewhat the appearance of *corrupta* Muls., being of about the same size as large specimens of the latter species; so the entomologists at Phoenix are not to blame for stoutly maintaining that this is a variation of the bean beetle. In other words, the extremely small dotted specimen received does present more of the appearance of *corrupta* than it does of the northern *borealis*. At this point it is interesting to remark that few species of beetles have such an extreme geographical range as *borealis*, which extends from Canada and New England through Central America into South America.

F. H. CHITTENDEN

A New 'Canker-Worm.' In the spring of 1923 the larvae of a Geometrid moth, *Coniodes plumogeraria* Hulst, totally defoliated over forty acres of walnut trees in the Simi valley, Ventura County, California.

According to H. G. Dyar this moth is not closely related to *Paleacrita vernata*. Like the latter, however, the female is wingless and the larvae have two pairs of prolegs. They also pupate in the ground and emerge in the spring.

There appears to be only one brood a year. This year the moths commenced to emerge the middle of February and the eggs to hatch the middle of March. Most of the eggs observed were deposited on twigs killed the previous seasons.

The wings of the male are silver-gray. The forewings are transversed by narrow wavy brown bands; four on each wing, the distal being most distinct. The characteristic marking on the hind wing is a brown spot near the center. The wing expanse measures 4½ centimeters from tip to tip. The antennae are light brown and beautifully plumose.

The female is brownish-gray. Ventrally, the abdomen is light gray; dorsally, it is tinged with bronze. In length the female measures 1 to 1½ centimeters.

The eggs are ovoid and slightly ridged. When first laid they are of an iridescent bronze but when about to hatch they are of a light blue.

The newly-hatched larvae are black with white patches along the lateral line. After feeding they turn brown but the white patches remain distinct for some time. The integument is sparsely covered with hairs and spined tubercles.

It is noteworthy that the infested orchard is some distance from any native growth and intervening orchards are apparently free.

STANLEY E. FLANDERS, *Entomologist, Saticoy Walnut Growers Assn.*

Woodpeckers and Smartweed Borer. In February, 1924, the State Entomologist at Ames, Iowa, received a package of dry corn stalks from Henry Marshall of Clear Lake, Iowa. They were found to be infested by larvae of the smartweed borer, *Pyrausta ainslieı* Heinrich. The sender stated in his letters that there seemed to be about two or three acres of stalks thus heavily infested in rather low ground. His attention was attracted by the activity of a number of downy woodpeckers, (*Dryobates pubescens medianus* Swainson). Though the day was bitterly cold and the field three-quarters of a mile from any kind of trees or shelter, yet these birds were busily pecking the stalks to pieces. Examination proved that they were getting about 90% of the larvae. There seemed to be little or no promiscuous prospecting on the part

of the woodpeckers, as they had evidently been able to locate the larva exactly in almost every instance. Because of the similarity of habits between the smartweed borer and the European corn borer, this bird may be especially worth encouraging in sections where the latter insect abounds.

J. E. GUTHRIE

NORTHEASTERN ENTOMOLOGISTS, SIXTH ANNUAL SUMMER MEETING, JULY 16-18 INCLUSIVE, 1924

The committee has prepared the following program for the field meeting for the summer of 1924:

JULY 15, TUESDAY

Headquarters for the evening to be at some hotel in Philadelphia where the rates are reasonable, and to which access by automobile and train is convenient. It is believed that hotel accommodations can be secured at rates from $2.50 to $3.00 for the night. Those coming to the meeting by train or by machine who are to spend the night in Philadelphia can be accommodated. It is not planned to have any formal program for the evening, but those present can visit informally.

JULY 16, WEDNESDAY

Leave the hotel at 9 a. m., daylight time, by machine, making first stop at Holmesburg, arriving there about 9:45 a. m., daylight time. Leave Holmesburg at 10:15 a. m., arrive at Bustleton 10:30 a. m., daylight. Those coming to the meeting by machine, but not arriving the previous evening, can meet the party at either of these two points, and may then proceed on the rest of the trip with the main party. Leave Bustleton at 11:30 a. m., arriving at Willow Grove at 12 noon, leaving 12:30, and arriving at Gwynedd at 1 p. m. Arrangements will be made to have lunch here, and leaving here at 1:40 p. m., arrive at West Chester about 5 p. m., on the way spending a few minutes at Valley Forge. Supper will be secured at West Chester from 5:30 to 6:30 p. m., and it is planned to spend the night at West Chester. After supper visit the Scalecide Demonstration Plot, returning to West Chester at 8 p. m. The Fruitgrowers Association of Chester County have invited the visiting entomologists to an informal gathering and smoker, for the rest of the evening.

JULY 17, THURSDAY

Leave West Chester at 8 a. m., daylight time, arriving at the Wilmington-Pennsgrove Ferry, at 10 a. m. Cross ferry, proceed from Pennsgrove to Glassboro or Bridgeton, N. J. Have lunch at either point, and proceed thence to Philadelphia. (It may be possible to make arrangements to stay over night at Bridgeton instead of returning to Philadelphia, although definite arrangements have not as yet been made). For the program on Thursday evening, arrangements have been made for Mr. J. L. King of the Japanese Beetle Laboratory to give an illustrated talk on his entomological experiences in Japan in connection with the Japanese beetle parasite work. This talk will be followed by a general discussion of the Japanese beetle project, and an informal discussion on any other points of common interest.

JULY 18, FRIDAY

Proceed Friday morning to Riverton, N. J. to spend the rest of the morning, (and as much additional time as individuals may desire) in looking over the Japanese

beetle work. Arrangements have been made for every facility to be given for inspecting the various phases of the Japanese beetle work at the Laboratory and in the field.

The program outlined above is definite as to its main points, although certain detailed arrangements are yet to be concluded. Before it is possible to definitely arrange for headquarters for Thursday night it will be necessary to have a general idea as to how many members will be present. Hotel accommodations for a large body of men in South Jersey are fairly limited.

Throughout the trip stops will be made at points where entomological projects are under way, such projects being conducted either under the direction of the Pennsylvania State College, or the Bureau of Plant Industry of the Pennsylvania Department of Agriculture, or the Bureau of Entomology of the Federal Department of Agriculture, or by these agencies in cooperation. It is planned to take in the field work in connection with the Japanese beetle, Oriental fruit moth, insecticide and fungicide tests being conducted under the general direction of the Crop Protection Institute, Angoumois grain moth, Greenhouse Insects, and general field projects on vegetable and fruit insects.

There is a lot of work of entomological interest being conducted in the district to be visited, and it is the hope of the committee that the meeting will be well attended and of interest and value to all.

Please note also that daylight saving time is used throughout the program above, since daylight time is in common usage in the districts to be visited.

For those who are not driving their own cars, provision will be made to find room for them in other cars, so that there will be room for all those who come whether they have their own machine or not.

Director C. H. Hadley, Bureau of Plant Industry, Harrisburg, Pa., wishes to be advised promptly, if this has not been done, as to the names of those attending, whether they plan to travel with their own cars and if so whom they plan to carry; also, indicate if there would be room for others. Suggestions as to individuals to whom notices should be sent would be welcome.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

JUNE, 1924

The editors will thankfully receive news matter and other items likely to be of interest to our readers. Papers will be published as far as possible in the order of reception, except that papers of reasonable length may be accepted in the discretion of the editor for early publication, at $3.00 per page for all matter in excess of six printed pages; in the case of other matter, the maximum of 2,500 words is still operative. Photo-engravings may be obtained by authors at cost.

Separates or reprints, if ordered, when the manuscript is forwarded or the proof returned, will be supplied to authors at the rates given below. Note that the number of pages in a reprint may be affected somewhat by the make-up, and that part of a page is charged as a full page. Carriage charges extra in all cases. Shipment by parcel post, express or freight as directed.

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The Proceedings of the Horticultural Inspectors and those of the Apiary Inspectors not having come to hand in a reasonably complete form, it has been considered advisable to defer publication of that matter to a subsequent number. Several other papers would have been included in the present number if authors had supplied abstracts with the copy or upon request. Over four months have elapsed since the annual meeting and yet not all the copy has been received and some of the authors have been too busy to supply the required abstracts.

The urgency of immediate publication can hardly be sustained in the face of the above. Conditions sometimes arise which might lead to the conclusion that need of early publication does not develop until the paper is written. An editor, not necessarily a scientist, may sometimes arrive at the conclusion that years are to be devoted to leisurely preparation of a manuscript and only a few days allotted to its passing through the press. It is true that investigation may and should consume ample time for the reaching of trustworthy conclusions. There are cases, however, where the "rush" to get into print does not harmonize with the period of compilation. A real contribution to knowledge rarely suffers much from delayed publication, despite the general application of the law of priority.

ARTHUR LESTER LOVETT

ARTHUR LESTER LOVETT was born at Neal, Kansas, on August 25, 1885. He died April 25, 1924, at Corvallis, Oregon, from septicemia poisoning. He graduated from the Oklahoma Agricultural and Me-

chanical College in 1906 and acted as entomologist and state inspector for that institution until 1911. He came to the Oregon Agricultural College as instructor in entomology and assistant entomologist of the experiment station in the spring of 1911. In 1916 he was made head of the department of entomology with the title of associate professor, succeeding Professor Harley F. Wilson. In 1917 he was made professor. He is survived by his wife, a son, and a daughter.

A. L. Lovett in the short time of seventeen years had attained leadership in his chosen profession. He had a wide knowledge of the insects of economic importance in the Pacific Northwest and was constantly consulted by growers and professional workers without regard to state or national boundaries. His contributions to our knowledge of spraying and spray materials are well known and he had established his reputation as an authority on insecticides. He was a pioneer in the scientific investigation of the use of spreaders for insecticidal sprays. In spite of his pressing duties in economic entomology, he found time, until recently, to make contributions to systematic entomology, particularly on the Syrphidae. His published papers, both technical and popular are characterized by a clarity of style and aptness of expression that have made his contributions particularly valuable. The loss to economic entomology due to his mature experience is incalculable.

His eager interest to promote professional intercourse and co-operation among entomological workers was illustrated by his leading part in the inauguration of meetings of professional workers interested in the agriculture of the Northwestern states and British Columbia, which afterwards developed into the informal organization known as the Northwestern Association of Horticulturists, Entomologists and Plant Pathologists. His own fine generosity, modesty, and vision of professional service were largely instrumental in determining the practice of free interchange of unpublished information on entomological problems, which has characterized this organization from the first. His passing will leave a void in this fellowship.

While entomology has suffered a real loss in his untimely death, his associates and co-workers in the Pacific Northwest, in the United States and in Canada, will feel intimately the loss of his virile personality. The happy comradeship of road, hotel, and camp, where he never failed "to hold up his end" as a joyous companion, in work or in play, will be sadly missed.

G. A. DEAN
R. C. TREHERNE
L. P. ROCKWOOD

Current Notes

Entomological News for May announces the deaths of Herbert Campion, London, England, January 24, and of Dr. L. Peringuey, at Capetown, February 20, 1924.

Mr.R. T.Cotton of the Bureau of Entomology has recently been operated upon for appendicitis, and is now rapidly recovering.

Dr. T. L. Guyton has been elected Assistant Secretary of the new Pennsylvania Academy of Science, organized at Harrisburg, April 18.

Mr. E. A. Vaughan of the Bureau of Entomology has been transferred from Thomasville, Ga., to general grain investigations at Orlando, Fla.

On March 19, Prof. C. L. Metcalf delivered the Sigma Xi lecture for the Illinois chapter on the subject "Methods of Warfare Against Insects."

Mr. J. R. Horton of the Bureau of Entomology was at Manhattan, Kansas, on April 3, for a conference with the Entomologists of the Kansas Experiment Station.

Miss Evelyn Wells and Mr. John Bailey, advanced students of the University of Tennessee, have accepted positions with the Department of Entomology, University of Tennessee.

Mr. Hushime Murayama is spending several weeks at the Division of Insects, U. S. National Museum, making drawings, chiefly of butterflies and moths, for the National Geographic Society.

Mr. C. C. Hamilton, Assistant Professor of Entomology in the University of Maryland, spent several days during March in the Entomological Laboratory at the Kansas State Agricultural College.

Mr. and Mrs. C. R. Cutright and their infant son, Holt, have returned to Wooster from Ohio State University, where Mr. Cutright has been pursuing experiments with subterranean aphids.

Mr. F. E. Whitehead, a graduate student of the Kansas State Agricultural College, has accepted a position as Extension Entomologist and Associate Professor of Entomology at the University of Idaho.

According to *Science*, Mr. Albert Hugh Jones, the English entomologist, who made important contributions to science while engaged in banking, has died at the age of 84 years.

Mr. Guy F. McLeod, Assistant Entomologist, New York Agricultural Experiment Station, Geneva, N. Y., has been appointed Assistant Professor of Extension Entomology at the Pennsylvania State College, State College, Pa.

Dr. William Barnes of Decatur, Ill., recently spent about three days in the Division of Insects, U. S. National Museum, consulting with Mr. Busck and examining types in the collection of Lepidoptera.

Mr. J. C. Bridwell, formerly of the Bureau of Entomology and recently continuing his work upon the classification of Bruchidae, has accepted a position at Columbia University as Lecturer in Extension Entomology.

Dr. James Zetek, in charge of the laboratory of the Bureau of Entomology at Ancon, Canal Zone, will shortly visit Washington for the purpose of discussing plans of future work at the station.

The periodical Cicada (*Tibicina septendecim*) *tredecim* race is due to appear in 35

counties of West and Middle Tennessee this year. This is brood 23 of the 13-year race of the periodical Cicada.

On February 22, 1924, the Degree of Doctor of Philosophy was conferred by George Washington University on Philip Luginbill, Entomologist in Charge of the Columbia, S. C., laboratory of the Bureau of Entomology.

Mr. G. F. Moznette, Bureau of Entomology, has nearly completed an extensive survey of the fruit culture of Cuba and the Isle of Pines for fruit flies in connection with plant quarantine regulations.

Mr. Arthur Finnamore has been promoted to District Insect Pest Inspector and will be stationed at St. John, N. B., as officer in charge of that port of importation for nursery stock and plant products.

Professors Herbert Osborn of Columbus, Ohio, C. R. Crosby of Cornell University, Ithaca, N. Y., and Dr. W. E. Britton of New Haven, Conn., were visitors at the Division of Insects, U. S. National Museum on April 28.

The Mexican Bean Beetle (*Epilachna corrupta* Muls.) has already appeared in several parts of the State of Tennessee this season and egg-masses have been taken. At present seventy counties are known to be infested with this pest.

There has been a very serious outbreak of the Strawberry Weevil (*Anthonomus signatus*) in four counties of Tennessee, Hamilton, Rhea, Roane and Gibson. Early strawberries have suffered from ten to sixty per cent from the infestation of this insect.

Prof. Herbert Osborn of the Ohio State University spent several days at the Kansas State Agricultural College while en route from California to his home. While at Manhattan, Prof. Osborn addressed the Science Club on "Insect Relationship to the Environment."

On March 6, Dr. H. E. Burke of the Bureau of Entomology lectured before the Zoological Club of Stanford University on "Fighting the Western Pine Beetle." The lecture was illustrated by the Department moving picture of the same title.

Dr. L. O. Howard, Chief of the Bureau of Entomology, will be Chairman of the conference considering the questions relating to food production and conservation at the Pan-Pacific Congress to be held at Honolulu, July 21 to August 14, 1924.

Dr. Albert Hartzell, who has been engaged in research work on sulphur as an insecticide for the Crop Protection Institute and located at the Agricultural Experiment Station, Geneva, N. Y., has recently been appointed Entomologist of the Boyce Thompson Institute for Plant Research, Inc., at Yonkers, N. Y.

Mr. L. R. Cagle, fellow, Department of Entomology, University of Tennessee, has recently accepted a position with Prof. W. J. Schoene, Blacksburg, Va. Mr. Cagle will pursue the work on the life history of the Oriental Peach Moth, being stationed at Leesburg, Va.

Entomological News records the death of Colonel Charles Swinhoe, Lepidopterist, at Avonmore, West Kensington, London, December 2, 1923, and of the Reverend Canon Theodore Wood, son of Reverend J. G. Wood, and author of various entomological papers, at Wordsworth Common, England, December 13, 1923.

According to *Science*, Mr. J. L. King, who recently returned from Japan after three years study of the parasites of the green Japanese beetle, is now appointed as specialist in charge of the division of parasites at the Japanese Beetle Laboratory, Riverton, N. J.

Mr. C. P. Clausen, in charge of the Japanese Beetle parasitic work in the Orient, who has been in Washington for a temporary period, sailed from San Francisco March 4, for Kobe, Japan, to resume his field operations in connection with parasites for the Japanese beetle.

Dr. E. A. Back of the Bureau of Entomology was subpoened to appear on February 18 and 19 as a witness in the Superior Court of Baltimore in connection with an explosion occurring on board a grain boat during August, 1923, following the application of carbon disulphide.

The U. S. National Museum has recently received 79 specimens of Palearctic cynipids in exchange with the Zoological Museum, Vienna, Austria. This exchange has been arranged through the activities of L. H. Weld and the kindness of Dr. Franz Maidl. Most of the material comes from the Mayr collection.

Dr. F. A. Fenton of the Iowa Agricultural Experiment Station, Ames, has been engaged to take charge of the boll weevil laboratory at Florence, S. C., conducted by the Bureau of Entomology, in co-operation with the South Carolina Experiment Station. Dr. Fenton was to enter upon his duties May 1.

A collection of 84 species of Orthoptera of western Canada, collected by Mr. E. R. Buckell, was recently forwarded to the Imperial Bureau of Entomology by the Dominion Entomologist. It is of interest to state that 39 of these species were not represented in the British Museum Collection.

New species of mosquitoes from the United States, especially from the region east of the Rocky Mountains, are very rare. The Museum has recently received specimens of a new form from Brownsville, Tex. This furnishes the first new species east of the Rocky Mountains since the publication of the monograph on Culicidae in 1917.

Mr. B. Preston Clark has recently forwarded to Mr. Schaus 10,000 specimens of Lepidoptera from the Philippines; 6,000 of these specimens represent butterflies and the remaining are moths. The material is being mounted and prepared for study and will ultimately be deposited in the collections of the U. S. National Museum.

Prof. R. W. Harned of Mississippi, Drs. Wilmon Newell and J. H. Montgomery of Florida, Otto Brown of Alabama, W. J. Schoene and T. C. Johnson of Virginia, Dr. T. J. Headlee of New Jersey and Dr. Wm. Moore of New York, recently visited the Division of Truck Crop Insects of the Bureau of Entomology.

According to *Science*, an amendment to the Department of Agriculture appropriation bill has been submitted by Senator Harris of Georgia, to appropriate $100,000.00 "for the extermination and prevention of the cotton boll weevil, including an investigation of processes of the manufacture of calcium arsenate and other poisons" to be used in connection therewith.

Mr. and Mrs. L. L. Huber, who have been stationed at Wooster during the winter, left March 22 for Oak Harbor, which will be headquarters for the European corn borer laboratory this season. Mr. Huber is now moving the laboratory equipment from Geneva, Ohio, where the laboratory was located last summer, to Oak Harbor.

According to the *Official Record*, a shipment of European parasites of the alfalfa weevil for introduction into the infested area in this country was recently sent to the Salt Lake City laboratory of the Bureau of Entomology from the European Corn

Borer laboratory in France. A couple of years' observation may be necessary, however, before they are released in the weevil-infested area.

Dr. M. W. Blackman of Syracuse, N. Y., recently spent a week in the U. S. National Museum studying the collection of Scolytidae. Dr. Blackman has previously had certain members of this group for study and is devoting a good bit of his time to an examination of the field and rearing notes concerning these species.

According to *Science*, Dr. Anton A. Dampf, director of the Zoological Institute of Königsberg, has received a call from the Agricultural College of Mexico City to take over the post of Professor of Applied Zoology and State Entomologist. Dr. Dampf was formerly on the staff of the colonial government of German East Africa.

Mr. N. F. Howard, Entomologist in charge of the Birmingham, Ala., laboratory of the Bureau of Entomology, visited Ohio during the early part of February and attended the Farmers' Week held by the Ohio State University at Columbus. He presented a paper on the Mexican bean beetle and discussed the proposed work in that State.

According to *Science*, the Department of Entomology at the University of Kansas has been reorganized, with Dr. H. B. Hungerford as head and also as State Entomologist for the southern half of the state. Other members of the Department are: Dr. Paul B. Lawson, Mr. Philip A. Readio, Mr. R. H. Beamer and Miss Kathleen Doering.

According to *Science*, Mr. Frank L. Thomas, acting entomologist of the Alabama Experiment Station, has been appointed chief entomologist of the Experiment Station and State Entomologist of Texas, the appointment becoming effective on May 1. He succeeds Dr. M. C. Tanquary, who has resigned in order to engage in commercial beekeeping with headquarters in Fargo, N. D.

Dr. H. G. Dyar has left for a three months' trip to the West Coast to study and collect mosquitoes. There are a few species occurring in the Western States which are unknown in the larval stages, and Dr. Dyar is very anxious to obtain notes on the habits and also a complete set of the immature stages.

Dr. G. C. Crampton of the Massachusetts Agricultural College was in the U. S. National Museum on March 10 and 11 consulting with various specialists in regard to some of his problems on insect anatomy. He also spent some time in the Division of Invertebrate Zoology consulting with Dr. Waldo L. Schmitt on some of the forms of Crustacea.

A recent conference was held in Philadelphia for the purpose of discussing all phases of the Japanese beetle project, including quarantine operations. Those present were Drs. T. J. Headlee and A. L. Quaintance, Messrs. L. B. Smith, C. H. Hadley, E. R. Sasscer, B. R. Leach, C. W. Stockwell, C. A. Thomas, E. R. Van Leeuwen, W. E. Fleming, G. B. Stichter, T. H. Worsinger, and Prof. C. A. McCue.

Prof. Geo. A. Dean of the Bureau of Entomology, visited the Columbia, S. C., laboratory March 26, the Department of Entomology of the North Carolina State College March 28. Since then he has traveled to Ohio, Iowa, Utah, Lawrence, Kan., and Webster Groves, Mo., to look after the work of his Division in the investigations of Cereal and Forage Crop Insects.

Mr. C. R. Neiswander, who has been pursuing anatomical and morphological studies with the larvae of the European corn borer at Ohio State University during

the past winter, spent the last week in March at Wooster in preparation for the summer's work. He and Mrs. Neiswander have joined the Hubers at Oak Harbor, where he will assist with field studies of the corn borer.

Mr. O. G. Babcock of the Bureau of Entomology left by automobile from his field station at Sonora, Tex., on April 17 for Carlsbad, N. Mex., where he will spend several days working with Mr. Vernon Bailey on an insect survey of the Carlsbad Cave. This is one of the largest caves in the world and will probably yield some interesting insect material.

Mr. Carl Heinrich of the U. S. National Museum left Washington early in March for a month's trip to study types of Microlepidoptera and to consult various specialists. He planned to visit the American Museum of Natural History, the Museum of Comparative Zoology, the National Museum of Canada, and the collections of Dr. Wm. Barnes, Decatur, Ill., and Miss Annette F. Braun, Cincinnati, Ohio.

The collections of Coleoptera and Lepidoptera made by the late Thomas G. Bishop, of Dalmore, Helensburg, have been given by his son, Mr. A. Henderson Bishop, to the University of Glasgow for its new Zoological Museum. This collection is contained in 18 cabinets enclosing 700 separate boxes, and numbers some thirty or forty thousand specimens, all beautifully mounted, labeled, systematically arranged and in perfect condition.

Dr. E. A. Back of the Bureau of Entomology read a paper on the effect of cold storage on insects before the 13th Annual Convention of the American Association of Ice and Refrigeration at the New Willard Hotel, Washington, D. C., in the latter part of March. Dr. Back went to New York April 8 to inform himself regarding development of certain so-called mothproofing treatments now being advertised rather extensively.

The Division of Insects, U. S. National Museum, has received for study a third shipment of types of American muscoid flies loaned by the Zoological Museum in Vienna, Austria. This material is a part of that which was the basis of Brauer and Bergenstamm's large work published some 30 years ago. The classification of the material in the National Museum will be very much improved by the study of these types.

Mr. A. E. Miller, who had been pursuing studies of Ohio mites at the National Museum, Washington, D. C., during the winter, has returned to the Field Laboratory at Chillicothe. He was at Wooster the last week in March for laboratory equipment. One of his major projects this year will be with the Mexican bean beetle. He determined while at Washington that he has many new species of mites in his Ohio collection.

Dr. Herbert Osborn, Research Professor, Ohio State University, delivered a series of four lectures in the University of Illinois, April 9 to 11 on the following subjects: (a) The Relation of Insects to Their Environment; (b) Entomological Explorations; (c) Opportunities and Qualifications for Entomological Work, and (d) Entomological Pioneers. On the evening of April 10, a dinner was given in his honor at which about 35 students and faculty members were present.

According to *Science*, Dr. W. M. Wheeler of the Bussey Institution, of Harvard University, was the guest of the Zoologists of Indiana University from December 10 to 12. He lectured before the chapter of Sigma Xi on "Bergson's Attitude Toward

Instincts," and before the convocation of the whole University on "Ants." These are the first public lectures in entomology to be given at Indiana University since the recent establishment of courses in entomology there.

An outbreak of the destructive spruce bark-beetle is apparently developing in Newfoundland. Infested logs and an account of the injury sent by the Newfoundland Department of Agriculture and by one of the lumber companies makes it certain that the species is at least abundant. Information which is expected to be received shortly will determine how extensive the outbreak has become and to what extent control measures will need to be applied.

The U. S. National Museum has recently received its first lot of Diptera from Greenland. This material was received as an exchange from the Zoological Museum in Denmark, and represents 80 of the named flies from this island. Flies are the most abundant insects in the Far North, the order Diptera being represented in Greenland by 188 species, while the Coleoptera are represented by 41, the Hymenoptera by 66, the Lepidoptera by 46, and Hemiptera by 12.

On March 3, 4 and 5, Mr. J. C. Evenden of the Forest Insect Field Station of the Bureau of Entomology, Coeur d'Alene, Idaho, gave a series of five illustrated lectures on Forest entomology to the forestry students at the University of Idaho, Moscow, Idaho. On March 10 and 11, Mr. Evenden attended the quarterly meeting of the North Idaho Forestry Association at Spokane, Wash. At this meeting considerable time was given to an informal discussion of forest insect problems.

According to *Science*, Prof. W. B. Herms, of the University of California, left San Francisco on the motor schooner "Doris Crane" on April 10, for Fanning Island, where he will study cocoanut pests. While in the South Seas, Prof. Herms will also carry out a general survey of the fauna and flora of Fanning and other neighboring islands. Mr. Harold Kirby, fellow in zoology, will assist in the work. The investigation will extend over a period of about four months.

Mr. H. G. Crawford, Entomological Branch, Canadian Department of Agriculture, attended a conference at Niagara Falls, Ont., on March 10, in connection with the investigations in the control of the European Corn Borer. Prof. G. A. Dean, D. J. Caffrey, H. N. Bartley, F. W. Poos and Prof. L. Caesar were in attendance. The U. S. officials had recently held a conference at Columbus, Ohio, with the Ohio State officials; the meeting at Niagara Falls reviewed fully the plans for next summer's operations in Canada and the United States.

Mr. William Fletcher Harding, Editor in the Bureau of Entomology, died of pneumonia, March 1, 1924, after only a few days' absence from his duties. Mr. Harding was born in Indianapolis, Ind., September 2, 1868, and graduated from the University of Indiana. He also received a master's degree from the University of Chicago. He entered the U. S. Department of Agriculture in 1903 as an editorial clerk in the Division of Publications and in 1922 was transferred to the Bureau of Entomology as Associate Editor.

Mr. N. G. Wessels, a student of the Government of the Union of South Africa, spent several weeks during January and February visiting the Bureau of Entomology laboratories at Dallas, Uvalde, and Sonora, Tex., in connection with his study of Angora goat production in this country. He also spent a few days in Washington just prior to sailing for England. Mr. Wessels is a student of Dr. R. O. Wohl who is

entomologist at the Grootfontein School of Agriculture, Middleburg, Cape, and visited this country some two years ago.

Recent appointments in the Bureau of Entomology are announced as follows: W. B. Wheelis, junior entomologist in research investigation on the Mexican bean beetle, Alfred Lutkin, agent in eradication of sweet potato weevil in southern Mississippi in co-operation with State Plant Board; Robert M. Fouts, field assistant, pecan insect investigations, Brownwood, Tex.; Travis E. McNeel, junior entomologist, malaria mosquito investigations, Mound, La.; W. D. Mecum, temporary field assistant, Madison, Wis.; L. W. Brannon, Mexican bean beetle laboratory, Birmingham, Ala.; P. R. Hickborn, pea aphis investigations, San Jose Valley, Calif.; F. A. Fenton, boll weevil laboratory, Florence, S. C.

An important conference was held at Tucson, Ariz., on April 10 to determine the best procedure to follow in view of the recent discovery of the Thurberia weevil in cotton grown near Tucson. It was attended by the Arizona Quarantine Commission, representatives of cotton planting interests in Arizona, and by W. D. Hunter, R. E. McDonald of the State Department of Agriculture, as well as A. W. Morrill and W. D. Pierce. The State Commission decided, on the advice of W. D. Hunter and R. E. McDonald, to establish a non-cotton zone extending about 30 miles from the Santa Catalina Mountains.

Dr. W. R. Dodson, Chairman of the Cotton Council of the Association of Southern Agricultural Workers, called a meeting at Atlanta, Ga., on April 14, for considering plans to use as nearly as possible a uniform system in planning and recording boll weevil experiments during the coming season. Such a course is highly desirable on account of the difficulty which has been experienced heretofore in comparing results obtained in experiments performed according to diverse plans. Entomologists from practically all of the Southern States except North Carolina and Florida were present. Mr. B. R. Coad represented the Bureau of Entomology. A definite program was worked out and adopted.

A conference of the entomologists of Ohio, especially those dealing with the corn borer problem, the county agricultural agents of the quarantine counties, and the editors of daily and weekly papers in the quarantined area, met at the offices of the *Ohio Farmer*, April 4, for the purpose of enlisting and co-ordinating the efforts of all these men and agencies to clean up effectually and destroy all the corn borer larvae possible this spring. The clean-up campaign is under the direction of T. H. Parks, extension entomologist, of Ohio State University. H. A. Gossard, J. S. Houser, L.L. Huber, and C. R. Neiswander attended the conference and will participate in the activities of clean-up week.

According to *Science*, on the afternoon of April 3, Prof. John Henry Comstock of Cornell gave an address on "Early Entomologists and Their Work" in the lecture room of the department of entomology of Stanford University. The lecture was attended by a number of professors and students of the University of California and of Stanford University, and by some of the entomologists of the California Academy of Sciences and others of the San Francisco Bay region. In the evening a dinner was given at the Stanford Union in honor of Professor and Mrs. Comstock. After the dinner, Professor and Mrs. Comstock both gave interesting talks. Dr. David Starr Jordan, chancellor emeritus of Stanford University, one of Dr. Comstock's first students in entomology, and others also gave very interesting talks.

On April 21 Dr. E. A. Schwarz was eighty years old. To celebrate his birthday and to show appreciation for his kindnesses the ladies of the Division of Insects, U. S. National Museum, gave him a magnificent bunch of roses with appropriate greetings. The same evening a dinner attended by 26 people was given in his honor at the Cosmos Club, at which Dr. Howard acted as toastmaster. Speeches were made by Dr. B. Pickman Mann, Dr. C. W. Stiles, Dr. E. D. Ball, Dr. J. M. Aldrich and others. All the speakers pointed out the value of Dr. Schwarz's services to the science of entomology, recalling instances that occurred during his past life. All expressed the opinion that the most important reason that Dr. Schwarz had so many friends was because he had always been willing to help others and had taken so much interest in the work of younger men. To these addresses Dr. Schwarz replied in his characteristic modest manner. The April number of the Proceedings of the Entomological Society of Washington was issued on April 21 with an appropriate editorial about Dr. Schwarz, and at the regular meeting on May 1, Dr. Howard gave a brief talk and exhibited a dozen lantern slides showing pictures of Dr. Schwarz taken at various times since his connection with the U. S. Department of Agriculture.

Notes on Horticultural Inspection

Mr. J. H. Moreland was recently transferred from Dr. Hunter's force to take up inspection work at Laredo, Texas.

Dr. Marlatt and Mr. L. A. Strong are attending a meeting of the Western Plant Quarantine Board at Denver, Colorado.

Mr. V. J. Shimer has been appointed Plant Quarantine Inspector in Charge at the port of Laredo, Texas, where he succeeds Mr. Edgar S. Jewell.

The Avocado Weevil has been collected several times in Avocado fruits taken from passengers coming across the Border at the ports of Brownsville, Laredo, Del Rio, Eagle Pass, and El Paso.

Mr. L. J. Bottomer and Mr. P. A. Hoidale, both of Dr. Hunter's force connected with the Pink Bollworm Eradication work in Texas, have been in Washington for several weeks, helping with the nursery inspection work during the rush season.

Mr. E. R. Sasscer recently made a trip to the Mexican Border for the purpose of consulting with the inspectors in charge of the various ports. Mr. Deputy, Chief Inspector, Border Inspection, joined Mr. Sasscer at Laredo, and accompanied him on the trip along the Border.

The Report of the Committee on Crown Gall Inspection, which was submitted to the American Phytopathological Society on December 31, 1923, and to the American Association of Economic Entomologists on January 1, 1924 at Cincinnati, Ohio, was adopted unanimously by the two organizations. The Report has now been published and has been distributed to the inspectors at all of the ports of entry.

A shipment of about two bushels of cotton in bolls, which was sent to this country for the purpose of testing ginning machinery, was intercepted at New York and a sample taken and sent to Washington. An examination of this sample resulted in collecting dead larvae of a lepidopterous insect, *Earias fabia* Stoll. This insect is known to be a serious pest of cotton in India and is a rival of the Pink Bollworm in the amount of damage caused to the cotton crop.

QUARANTINE CONFERENCE

A three day conference of State and Federal Nursery Inspection Officials was held in Washington from April 28th to 30th. The purpose of the meeting was to arrive at a clear understanding of the limitations of State and Federal Quarantine powers with the object in view of securing the best possible co-operation in placing and enforcing the necessary Quarantines. In preparation for the conference, a summary of the State Quarantines and regulations pertaining to the movement of Nursery Stock was prepared. The recommendations of the Plant Quarantine conference as approved by the representatives from the various States were drawn up for presentation at the meeting of the Western Plant Quarantine Board. The following entomologists and inspection officers represented their respective States: Alabama, O. Brown; Arkansas, Geo. G. Becker; California, Lee A. Strong; Connecticut, W. E. Britton; Florida, Wilmon Newell, F. M. O'Bryne, J. H. Montgomery and O. T. Stone; Georgia, Jeff Chaffin; Indiana, Frank N. Wallace; Maryland, Ernest N. Cory, Geo. S. Langford, S. F. Potts, P. D. Sanders, T. B. Symonds and A. F. Woods; Massachusetts, R. H. Allen; Michigan, L. R. Taft; Mississippi, R. W. Harned, Hunter H. Kimball; New Hampshire, W. C. O'Kane; New Jersey, Thomas J. Headlee; New York, Geo. G. Atwood, C. R. Crosby; North Carolina, T. B. Mitchell; Ohio, Richard Faxon; Pennsylvania, C. H. Hadley; South Carolina, A. F. Conradi; Virginia, W. J. Schoene, T. C. Johnson; West Virginia, W. E. Rumsey; Wisconsin, L. R. Jones. The Federal Horticultural Board was represented by C. L. Marlatt, W. A. Orton, H. F. Kellerman, Geo. B. Sudworth, E. R. Sasscer, L. A. Strong, R. K. Beattie, David Lumsden, R. C. Althouse. The Bureau of Entomology was represented by A. L. Quaintance, W. R. Walton, A. F. Burgess, D. M. Rogers, L. H. Worthley, H. L. Blaisdell, C. W. Stockwell, Loren B. Smith, Harold Morrison and F. G. Robb. The conference was addressed by Secretary Henry C. Wallace and by Thomas G. Shearman, Assistant Solicitor. Professor W. C. O'Kane was elected Chairman of the conference and R. C. Althouse, Secretary. A committee was appointed to prepare recommendations in the form of a report to be submitted to the conference before adjournment. The personnel of the committee was as follows: W. C. O'Kane, Chairman, W. E. Britton, Wilmon Newell, Frank N. Wallace, Lee A. Strong, C. L. Marlatt, W. A. Orton, Geo. B. Sudworth and H. F. Kellerman. This committee reported as follows:

THE BASIS OF AGREEMENT: In this conference of State and Federal officials concerned in the promulgation and enforcement of plant quarantines established for the prevention of spread of plant pests and for their control or eradication, it is recognized that we have a common purpose, that the State and Federal powers are complementary, and that both are essential for such control. The principal purpose of the conference, therefore, is to secure full co-operation and to eliminate conflicting action. With this in view, it is the sense of this conference that such full co-operation on the part of the State and Federal plant quarantine officials shall be mutually accorded and accepted in all procedure both with reference to the readjustment of existing State and Federal plant quarantines and their enforcement and with regard to the promulgation of future plant quarantines.

SCOPE OF QUARANTINE ACTION: Recognizing that plant quarantines are often the only feasible means of preventing the entry or controlling the spread of diseases and insect pests, it is nevertheless obvious that such quarantines should be established only when the economic benefit to a region, State or country clearly outweighs the

inconvenience, expense, and loss that such quarantines may occasion. Such quarantines may be divided into the following classes: First, restrictive quarantines. These should be employed whenever their action will sufficiently accomplish the purpose sought. Restrictive quarantines are believed to be sufficient for the following subjects: (a) Where adequate safeguards by inspection and treatment are believed to be feasible. (b) For diseases or pests of long establishment or of wide distribution, where retardation of spread is believed to be the only object that is practicable of accomplishment. (c) For diseases or pests of minor economic significance which can be at least partially controlled by inspection without heavy expenditure and without entailing heavy losses. Second, embargoes. These should be employed only where restrictive quarantines are inadequate. The employment of an embargo may be justified in cases where the infection or infestation is of such types as: (a) The presence of which can not with reasonable certainty always be determined by inspection; for example, white pine blister rust, citrus canker, Oriental peach moth, and satin moth; (b) Where the volume or nature of the material involved makes efficient inspection economically impracticable; for example, the inspection of hay for the presence of alfalfa weevil; (c) Where adequate inspection at point of origin is not maintained and there remains risk or danger of escape of injurious insects or the establishment of a plant disease either in transit or at destination regardless of inspection at destination; for example, shipments infested with the Mexican bean beetle; (d) Where the elimination of host plants for the purpose of eradication or control of a disease or pest is under way in a region and these plants whether attacked or not may jeopardize the eradication or control activities.

CORRELATION OF STATE AND FEDERAL ACTION: It is the sense of this conference that all State quarantines should be so limited in subject and scope as not to conflict with existing Federal quarantines, and that all State quarantines now in force which are in conflict with such Federal quarantines should be modified so as to eliminate such conflict. It is further understood that, in any case where it is considered inexpedient for the Federal quarantine to cover the entire subject necessary for the protection of a State, any additional protection which the State may need is understood to be left open for State action. If such State action is taken it is understood that it should be supplemental to, but not in conflict with, the action taken under the Federal quarantine. It is understood and agreed that the needs of a State with respect to any plant quarantine subject may be presented to the Federal Horticultural Board at any time, but preferably at the original or other stated hearing, and that so far as the Federal Horticultural Board shall deem such incorporation practicable after full discussion and consideration with the State authorities, such needs shall be incorporated in the Federal regulations. *Example:* This may include provision for so routing movement within a State as to provide for reinspection by State officials at designated concentration points somewhat on the plan of the postal provision for such routing and inspection of parcel post packages of plants. It is also understood that with respect to any subject on which the Federal Horticultural Board has not acted the State may act. It is recommended also that where existing State legislation is inadequate to secure full co-operation between State and Federal authorities and to enable State authority to be conferred upon Federal inspectors an attempt shall be made to obtain enabling legislation. As a knowledge of the final destination of plants is a very important factor in the control of plant pests it is the sense of this conference that the Federal Horticultural Board should promptly send notice to the proper au-

thorities of the State of destination, whenever requested to do so, as to every shipment of plants from an area under Federal quarantine, giving the name and address of both the consignor and the consignee, and the number and kind of plants included in the shipment.

NOTIFICATION BY A STATE OF PROPOSED ACTION: A State considering the issuance of a quarantine or other regulation of interest to another State shall send notice, as far in advance as practicable, to the Federal Horticultural Board, to plant quarantine officers of other States, and to others in interest.

NOTIFICATION BY A STATE OF ACTION TAKEN: In case a State enacts legislation or issues a quarantine or other regulation or modification of existing regulations, whether referring to interstate or to intrastate movements copies of the new or amended measure shall be sent immediately to the Federal Horticultural Board, to plant quarantine officers of other States, and to others in interest.

NOTIFICATION OF CHANGES IN PERSONNEL: The Federal Horticultural Board and plant quarantine officers of all States should be kept notified of all changes in responsible plant quarantine officers.

APICULTURAL NOTES

Mr. George H. Rea assisted Prof. G. M. Bentley in a series of beekeeping meetings in Tennessee during the month of April.

A meeting of the Maine State Beekeepers' Association was announced for April 2, at the University of Maine. Mr. Geo. Yeaton is Secretary.

Dr. E. F. Phillips and A. P. Sturtevant of the Bureau of Entomology recently made a short trip to New York State in connection with work on bee diseases.

Mr. E. L. Sechrist of the Bureau of Entomology attended a series of annual meetings of the State Beekeepers' Association in Tennessee, Arkansas and Missouri, beginning on February 1.

Dr. A. P. Sturtevant of the Bureau of Entomology will go to Wyoming early in June for the purpose of investigating the sacbrood of the northern part of the state, which is often serious.

An appropriation has been made to the New York State College of Agriculture for a professorship of Apiculture and provisions have also been made for the continuation of the extension work in beekeeping.

At the annual meeting of the Connecticut Beekeepers' Association held at Hartford, April 26, the following officers were elected: President, Allen Latham, Norwichtown; Vice-President, J. D. Kroha, Danbury; Secretary-Treasurer, C. H. Rost, Meriden.

Mr. J. I. Hambleton of the Bureau of Entomology attended the two series of meetings held by the University of Illinois, one at Carbondale February 20 and 21 and the next at DeKalb February 22 and 23.

A short course in beekeeping, May 13-16, has been announced by the Division of Bee Culture of the University of Minnesota. This course is in charge of Professor Francis Jager and given at University Farm, St. Paul, Minn.

Mr. J. H. Heatherly, State Apiarist of Tennessee, has resigned on account of ill health and Mr. W. L. Walling of Knoxville has been appointed in his place. Mr.

Walling will work under the supervision of the State Entomologist, Prof. G. M. Bentley.

Recent visitors to the Bee Culture Laboratory of the Bureau of Entomology were: Prof. N. E. Phillips, Extension Apiarist, and D. L. Van Dine, Extension Entomologist, both from State College, Pa. Dr. E. Kohn of Grover Hill, Ohio, and Dr. L. D. Leonard of Minneapolis, Minn., both prominent beekeepers, also visited the laboratory.

Dr. E. F. Phillips attended the annual meeting of the Ohio State Beekeepers' Association held at the Ohio State University, Columbus, on February 7 and 8, and the following week attended a special series of meetings for beekeepers held by Purdue University, Lafayette, Ind. While in Lafayette, Dr. Phillips spoke before the monthly meeting of the extension staff of the University.

The importance of the winter packing of bees is emphatically shown by the condition of the bees in Tennessee this spring. Those who packed allowing proper amount of stores for their colonies already have eight frames of brood. Those who did not direct attention to packing, although with plenty of stores, have come through in a weakened condition.

Messrs. Lloyd M. Bertholf and Bruce Lineburg, who were employed at the Bee Culture Laboratory of the Bureau of Entomology last summer, will return there for work about June 1 for the summer period. Mr. Carlton Burnside, a graduate of the University of Michigan, will also be at the laboratory to investigate the fungi of the alimentary tract of the adult bee.

According to *Gleanings in Bee Culture*, Mr. Warren Whitcomb, a senior in agriculture at the University of New Hampshire, is making a survey of the beekeeping industry of New Hampshire with special reference to the kinds and amount of honey produced and the disease conditions. Mr. Whitcomb will give particular attention to the eradication of brood diseases as New Hampshire has no foul brood law, and consequently is not permitted to send bees into neighboring states.

Prof. R. B. Willson, Extension Specialist in Apiculture at Cornell University, Ithaca, N. Y., gave a radio talk on "The Uses of Honey" from Station WEAF, New York City, on February 27, and on account of it received 372 requests for the Government Bulletin, "Honey and its Uses in the Home." Prof. Willson in company with some of the New York apiary inspectors, planned to visit Medina and Ashtabula, Ohio, early in April, to study, first hand, the problems connected with the sterilization of diseased combs by the alcohol-formalin method.

Plans for the VII International Apicultural Congress are progressing satisfactorily and the final program will be issued about June 1. Information regarding the details of the Congress may be obtained from M. C. Vaillancourt, Ministéré de Agriculture, Quebec, who has charge of the arrangements. The proceedings of the Congress will be held in both French and English and all papers submitted will be translated so that they may be read in both languages. Following the meetings of the Congress, to be held September 1-4, several interesting excursions are arranged for those in attendance, including one to the Saguenay River on a specially chartered boat.

Notes on Medical Entomology

Prof. G. M. Bentley gave a talk on *Hypoderma lineata* before the Agricultural Club of the University of Tennessee on April 30, accompanying his talk with U. S. motion picture reel on this insect.

A number of cities in the Southwest are beginning active campaigns against mosquito breeding places with a view to preventing a recurrence of the dengue epidemic, and also to reduce malaria incidence as well as eliminate annoyance from mosquitoes.

Mr. William A. Hoffman from the School of Public Health, Johns Hopkins University, recently spent several days at the U. S. National Museum in studying blood-sucking flies. Mr. Hoffman was especially interested in members of the genus Culicoides and related forms.

Mr. W. E. Dove, who was formerly connected with the office of the Bureau of Entomology dealing with insects affecting live stock has been reappointed and is to devote the major part of his time to investigations of the cattle grub, screw worm and horse flies. His headquarters will be Dallas, Texas.

About the middle of May, Dr. Roark of the Bureau of Chemistry reached Dallas where he is to work co-operatively with the agents of the Bureau of Entomology on the problem of developing satisfactory repellents for the screw worm and related blow flies. Considerable time is to be spent on ranches in the vicinity of Uvalde, Texas, in the actual treatment of screw worm cases.

The Bureau of Entomology recently received for identification a larva of *Hypoderma lineatum* Vill., from the Parshall, N. D., Public Health Laboratory, sent in by Dr. P. B. Carter, who stated that it had been taken from the elbow of a little girl five years of age. It had burrowed under the skin across the child's back. This maggot normally lives in cattle, burrowing into the skin in the same way.

Prof. F. M. Root, of the School of Public Health, Johns Hopkins University, spent a day in the U. S. National Museum consulting with Mr. Greene on characters of muscoid larvae. Dr. Root has recently published a short paper setting forth some of the characters of these larvae, and Mr. Greene has also spent considerable time on members of the same group. Dr. Root was also interested in the South American fleas and mosquitoes.

Mr. Eric Hearle of the Vernon, B. C., Laboratory, Entomological Branch, Canadian Department of Agriculture, visited Kelowna on February 8 and 9 in connection with mosquito control work as a result of a request from the local committee in charge. Arrangements have been completed for continuing the control work in the Banff district. Mr. Hearle reports that the season is greatly advanced and the weather milder than has occurred during the same period for seventeen years.

ECONOMIC ENTOMOLOGY AND PHYTOPATHOLOGY

It will be recalled that Dr. L. O. Howard, in his report as Delegate to the International Conference of Phytopathologists and Economic Entomologists held in Holland last June, see pages 9–14 of the February issue, included some correspondence relative to the European use of the word phytopathology as comprehending insect depredations as well as plant diseases. Through the Secretary of Agriculture, the matter was brought before the International Institute at Rome.

The following communication is self explanatory:

INSTITUT INTERNATIONAL
D'AGRICULTURE

LE DÉLÉGUÉ
DES ÉTATS-UNIS-D'AMÉRIQUE

ROME, May 17, 1924.

Dr. L. O. Howard, Chief, Bureau of Entomology,
U. S. Department of Agriculture, Washington, D. C.

DEAR DR. HOWARD:

Your proposal to change the name of the 3rd Bureau of the International Institute of Agriculture from Bureau of Agricultural Information and Plant Diseases to Bureau of Agricultural Information and Plant Protection was submitted to the General Assembly for consideration.

After discussion it was decided that both the present name and the proposed title were rather long and that the word "information" was too indefinite as an indication of the activities of the Bureau. Hence, the name of the Bureau was changed to the shorter title of "Bureau of Agricultural Science."

The complete resolution as passed is as follows:

"The 3rd Bureau shall in future be called in French 'Bureau de Reseignements Agricoles' and in English 'Bureau of Agricultural Science'."

I hope that this change fully meets the objections raised by you against the old name.

Yours truly,

ASHER HOBSON,
Delegate of the United States